PNE-959

CABRIOLET

REPORT OF OFF-SITE SURVEILLANCE FOR PROJECT CABRIOLET

THIS DOCUMENT CONFIRMED AS
UNCLASSIFIED
DIVISION OF CLASSIFICATION
BY 9 H Kahn/amd
DATE 12/16/71

Issuance Date: December 27, 1971

U.S. PUBLIC HEALTH SERVICE
LAS VEGAS, NEVADA

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

PLOWSHARE
UNITED STATES ATOMIC ENERGY COMMISSION
CIVIL, INDUSTRIAL AND SCIENTIFIC USES FOR NUCLEAR EXPLOSIVES

32463

NOTICE

This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Atomic Energy Commission, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

This report has been reproduced directly from the best available copy.

Available from the National Technical Information Service, U. S. Department of Commerce, Springfield, Virginia 22151.

Price: Paper Copy $3.00
Microfiche $0.95.

Printed in the United States of America
USAEC Division of Technical Information Extension, Oak Ridge, Tennessee

PNE-959
NUCLEAR EXPLOSIONS — PEACEFUL APPLICATIONS (TID-4500)

REPORT OF OFF-SITE SURVEILLANCE FOR PROJECT CABRIOLET

by
Environmental Surveillance
Southwestern Radiological Health Laboratory*

ENVIRONMENTAL PROTECTION AGENCY

NOTICE

This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Atomic Energy Commission, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

Published May 1971

This surveillance performed under a Memorandum of Understanding (No. SF 54 373) for the U. S. ATOMIC ENERGY COMMISSION

*Formerly part of U. S. Department of Health, Education, and Welfare, Public Health Service, Environmental Health Service, Environmental Control Administration, Bureau of Radiological Health

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

ABSTRACT

Project Cabriolet was a 2.5-kiloton nuclear excavation experiment conducted at the Nevada Test Site on January 26, 1968, as part of the Plowshare program. The results of the off-site radiological surveillance program conducted for this event by the Public Health Service are presented in this report.

Aircraft and ground monitoring teams documented the radioactivity discharged to the atmosphere from this event as it traveled northward from the Nevada Test Site into southern Idaho, then north-eastward where it was detected as far as Big Timber, Montana. The highest external gamma exposure rate observed off-site was 65 mR/h measured at Clark Station, Nevada, during cloud passage by a permanent exposure rate recorder. This is a populated location 61 miles from ground zero on an azimuth of 353°. The exposure at Clark Station for cloud passage plus seven days residual activity was 8 mR. The highest exposure from cloud passage in the off-site area as measured by thermoluminescent dosimeters was 12 mR two miles west of Clark Station.

The highest integrated gross beta activity observed in air at a populated location was 560 $\mu Ci\text{-}sec/m^3$ at Stone Cabin Ranch, 65 miles from ground zero on an azimuth of 355°. This sample was collected during the cloud passage period from 1020 to 1500 PST, January 26. The highest iodine-131 concentration observed in milk was 630 pCi/liter in a sample collected 14 days after the detonation at Mountain View Ranch near Wells, Nevada. No radioactivity was detected in milk or air samples collected beyond the northern Nevada border. Low levels of residual activity were detected in snow samples collected as far northeast as Big Timber, Montana.

PREFACE

The Southwestern Radiological Health Laboratory (SWRHL) serves as the Off-Site Radiological Safety Organization for the AEC in accordance with an AEC-PHS Memorandum of Understanding, No. SF 54 373, as amended. SWRHL also represents the Bureau of Radiological Health, and maintains close working relationships with the States and other components of the Bureau. State and other Bureau surveillance networks are alerted as appropriate to assist in documenting radioactive releases to off-site areas associated with AEC testing programs.

The Director, Southwestern Radiological Health Laboratory, or his designee, serves as the Off-Site Radiological Safety Officer on the staff of the Test Manager, NVOO, AEC. The radiological safety guidelines established by the AEC as applicable to the off-site area are set forth in Item II-A of Chapter 0524, "Standard Operating Procedures, Nevada Test Site Organization." The responsibilities of the Southwestern Radiological Health Laboratory include:

1. Documenting the radiological situation in off-site areas through comprehensive environmental sampling and radiation monitoring.
2. Assuring continuous protection of public health and safety by determining potential and past exposures, and implementing protective measures as directed by the Test Manager.
3. Conducting a public contact and information program in the off-site area to assure local residents that all reasonable safeguards are being employed to protect public health and property from radiation hazards.

4. Collecting information regarding incidents which may be attributed to radioactive releases to the off-site area.

5. Conducting special studies to determine the transport of radioiodine in environmental and biological systems.

Note: At the time this work was performed the SWRHL was a part of the Public Health Service, U. S. Department of Health, Education, and Welfare. In the latter part of 1970, SWRHL was transferred to the Environmental Protection Agency.

TABLE OF CONTENTS

	Page
ABSTRACT	i
PREFACE	iii
LIST OF FIGURES	vi
LIST OF TABLES	vii
INTRODUCTION	1
OPERATIONAL PLAN	2
RESULTS	3
Aerial Monitoring	3
Ground Monitoring	4
Vegetation Sampling	6
Air Sampling	6
Milk Sampling	8
Milk Cow Feed Sampling	9
Water and Snow Sampling	9
Dosimetry	10
Whole Body Counting	12
Medical and Veterinary Support	13
DISCUSSION	13
Cloud Travel	13
Airborne Radioactivity	13
Radioiodine in Milk	16
SUMMARY	17
LIST OF APPENDICES	37

LIST OF FIGURES

Figure		Page
1	Ground Monitoring Locations by Portable Survey Instruments	20
2	Vegetation Sampling Locations	21
3	Air Sampling Locations	22
4	Milk Sampling Locations	23
5	Standby Milk Sampling Locations Sampled for Cabriolet	24
6	Milk Cow Feed Sampling Locations	25
7	Water Sampling Locations	26
8	Snow Sampling Locations	27
9	Survey Meter Results - Clark Station	28
10	Survey Meter Results - Stone Cabin Ranch	29
11	Exposure (TLD's) on Highways 6 and 25	30
12	Maximum TLD Exposure versus Distance	31
13	Downwind Exposure Pattern	32
14	Cabriolet Activity as Detected on the Ground	33
15	Cloud Transport Speed (Leading Edge)	34
16	Integrated Iodine-131 and Gross Beta Particulate Concentration	35
17	Iodine-131 in Milk versus Time (Mountain View Ranch)	36

LIST OF TABLES

Table		Page
1	Locations of Natural Vegetation Samples Containing Cabriolet Related Activity	6
2	Highest Integrated Activities in Air ($\mu Ci\text{-}sec/m^3$) (Charcoal Cartridge and Filter)	8
3	Maximum ^{133}I Dose Computed from Whole Body Count	12

INTRODUCTION

Project Cabriolet was a nuclear experiment in hard, dry rhyolite rock executed as a part of the Plowshare Program for development of nuclear excavation. Cabriolet was detonated on 26 January 1968 at 0800:00.105 (PST), 1600:00.105 (GMT), in Area 20, Nevada Test Site (NTS). The resultant yield was 2.3±0.5 kt. The emplacement hole was U20l at geodetic coordinates:

Longitude: W 116° 30' 52.0082"

Latitude: N 37° 16' 51.0715"

Surface ground zero (GZ) was 6197 feet MSL; emplacement depth (to the working point) was 170.75 feet. The resultant crater was characterized by the following dimensions and volumes:

1)	Radius of apparent crater (R_a)	54.68 meters	179.4 ft
2)	Maximum depth of apparent crater (D_a)	35.48 meters	116.4 ft
3)	Av. Apparent crater lip crest height (H_{al})	9.69 meters	31.8 ft
4)	Radius of apparent lip crest (R_{al})	65.14 meters	213.7 ft
5)	Radius of outer boundary of continuous ejecta (R_{eb})	201 meters	660 ft
6)	Lip volume, apparent	184,900 cubic meters 241,887 cubic yards	
7)	Crater volume, apparent (V_a)	137,600 cubic meters 180,025 cubic yards	

Under a Memorandum of Understanding with the Atomic Energy Commission, the Southwestern Radiological Health Laboratory (SWRHL) conducted a program of radiological monitoring and environmental sampling to document levels of airborne and deposited radioactivity released to the off-site area surrounding the Nevada Test Site. This report summarizes the procedures used for the off-site surveillance operations and presents the data obtained.

OPERATIONAL PLAN

The SWRHL procedures for the Project Cabriolet off-site surveillance program are described below. Information from SWRHL aerial cloud tracking was used to position portable air samplers downwind prior to cloud passage to supplement permanent air sampling stations. Film badges and/or thermoluminescent dosimeters (TLD's) were placed along roads approximating arcs downwind of ground zero to document exposures due to cloud passage and to residual deposition at varying distances from ground zero. TLD's were also issued to certain off-site residents in the proposed trajectory to document personnel exposures. Special samples for radioassay were collected from routine air, milk, and water sampling networks in the off-site area and from supplementary sampling locations in the Cabriolet effluent trajectory following the experiment.

A "hot-spot" monitoring team, using a portable 4- by 4-inch NaI(Tl) detector in conjunction with a counting scaler to measure gross gamma activity, surveyed the trajectory area following cloud passage in search of "hot-spot" deposition areas which may have resulted from rain-out or snow-out during cloud passage. Other monitoring teams collected snow, water, and vegetation samples to augment their gross gamma activity measurements in order to define the low levels of deposition at the greater distances from ground zero. Ground monitors collected natural vegetation samples along roads closer to ground zero (within 300 miles) to define activity deposition boundaries.

A medical officer and four veterinary officers were on standby at SWRHL to assist in investigating claims of injury or property damage allegedly resulting from the Cabriolet experiment. The medical officer also directed the SWRHL whole body counting facility, which was used to assay internal absorbed doses of SWRHL field personnel exposed to contaminants during the surveillance operations. The whole body counting facility and a mobile thyroid counting trailer were also available for counting off-site residents at the request of the Test Manager.

Procedures for the analyses of air, water, milk and vegetation samples collected for Cabriolet are described in SWRHL Handbook of Radiochemical Analytical Methods (SWRHL-11).

RESULTS

Aerial Monitoring

Aerial tracking of the radioactivity released by the Cabriolet detonation was conducted by SWRHL monitors equipped with portable survey instruments aboard an Air Force aircraft, and two SWRHL Turbo-Beech aircraft equipped with special instruments for cloud tracking and sampling. The USAF aircraft refrained from entering the cloud in its early stages since the initial portion of the mission was to define only cloud boundaries and direction of movement.

The peak exposure rate observed in the cloud as it passed the Nevada Test Site controlled area boundary 40 miles from ground zero was 40 mR/h at an altitude of 6,000 feet above mean sea level (MSL). The leading edge of the cloud at 7,000 feet MSL crossed Highway 6, 60 miles from ground zero at approximately 1000 hours PST. Total cloud width at this altitude as it crossed the highway was approximately 35 miles.

The Turbo-Beech aircraft tracked the cloud between 60 and 100 miles from ground zero from 1054 to 1204 hours. The final tracking mission located the trailing edge at 1620 hours, 15 miles north of Eureka, 180 miles from ground zero. A weather front prevented the aircraft from reaching the leading edge, although positive contact was maintained to a point over the Ruby Mountains 10 miles east of Elko, then east to Hogan (60 miles east of Elko) at 1700 hours, and south to Currie at 1717 hours. Cloud samples were collected by the aircraft at 1015 and 1650 hours PST. Results will be reported in the final report of Aerial Surveillance for Cabriolet.

Peak exposure rate readings in the Ruby Mountain area from 150 to 230 miles from ground zero between 1700 and 1717 hours at 9,000 and 10,000 feet MSL were approximately 0.01 mR/h. Background levels were 0.02. Due to restrictive flying conditions, these readings were probably not obtained in the area of highest activity in the cloud.

Aerial tracking could not be continued beyond the Elko area due to darkness and severe weather conditions. No tracking missions were flown by SWRHL aircraft on subsequent days.

Ground Monitoring

A summary of the monitoring readings observed in the off-site area is given in Appendix B and shown in Figure 1. All readings are gross gamma exposure rates at 3 feet measured with a Geiger-Muller (GM) survey meter (Eberline E-500B).

The maximum exposure rate observed at a populated location during cloud passage was 65 mR/h as recorded by a permanent exposure rate recorder at Clark Station, 61 miles from ground zero. A monitor at this location recorded 43 mR/h using an E-500B survey instrument. The second highest reading at a populated location was 20 mR/h at Stone Cabin Ranch, 65 miles from ground zero. Maximum gamma levels observed during cloud passage at populated locations other than Clark Station and Stone Cabin Ranch were less than 0.5 mR/h . Peak readings of less than 0.1 mR/h were found upon remonitoring the deposition pattern along Highway 6 from Warm Springs to 17 miles west of Clark Station at six to eight hours after cloud passage. Remonitoring data are also summarized in Appendix B.

Cloud passage monitoring results on Highway 50 from Ely to Austin, approximately 170 miles from ground zero (1328 to 1511 PST), indicated a peak activity of 0.3 mR/h at 1343 hours, 20 miles west of Eureka. At 1430 hours, the highest reading along Highway 50 was 0.06 mR/h 20 miles west of Eureka. Remonitoring along Highway 50 on the following day indicated no residual activity above survey instrument detection limits (approximately 0.02 mR/h).

Highways 93 and 40 were surveyed after cloud passage with a 4- by 4-inch NaI(Tl) crystal detector which could be connected either to a portable scaler-timer for gross count information, or to a 400-channel gamma spectrometer to obtain data for radionuclide identification. The system was not calibrated to provide exposure rates; measurements are given as a function of background activity. Gross gamma activity of

twice background was found five miles south of Wells, Nevada, on Highway 93 at 1945 hours and snow was encountered three miles south of Wells. At that point the activity increased to five times background and remained at that level through Wells. Heavy snow was falling as the team proceeded west on Highway 40 from Wells to Elko between 2130 and 2300 hours. Gross gamma activity increased to a maximum of 40 times background 10 miles west of Wells. The western edge was near Elko, but was not determined exactly because of vehicle contamination.

Highway 40 was surveyed west from Elko with a GM survey meter, starting at 1800 hours on January 26. No activity levels above background were detected. This would indicate that the western edge of the deposition pattern was east of Elko. Another team located the eastern edge of the deposition pattern at 2200 hours ten miles east of Wells on Highway 40.

The following day the 4- by 4-inch detector system was used to survey Highway 93 from Wells to Twin Falls, Idaho, then east on Highway 30 to Burley, Idaho. A background survey was made of the same area five months later. No significant difference was found between the two sets of measurements. Gamma spectra obtained at several locations during the survey were not discernably different from background spectra.

Analysis of vegetation samples collected by the hot-spot teams indicated activity deposition from 30 miles west of Wells on Highway 40 to 36 miles north of Wells on Highway 93. Several snow samples along these two highways and in the vicinity of Burley, Idaho, also contained Cabriolet activity.

Vegetation Sampling

After cloud passage, natural vegetation samples were collected from downwind areas in Nevada and Idaho in order to delineate areas of residual activity. Samples containing radioactivity which could be attributed to Cabriolet were found only in Nevada.

Positive vegetation sample locations are listed in Table 1 and shown in Figure 2. Appendix C lists all the vegetation samples collected plus two dry hay samples and one pasture sample collected as cow feed where no milk was available.

TABLE 1

Locations of Natural Vegetation Samples
Containing Cabriolet Related Activity

1. From 25 miles east to 90 miles east of Tonopah on Highway 6.
2. From junction of Highways 6 and 25 (Warm Springs) to Diablo Maintenance Station on Highway 25.
3. From 31 miles west to 40 miles east of Eureka on Highway 50.
4. Duckwater, Highway 20.
5. From 30 miles west, on Highway 40, to 36 miles north, on Highway 93, of the junction of Highways 93 and 40 (Wells, Nevada).

Air Sampling

Fourteen stations in Nevada from the SWRHL air sampling network collected Cabriolet related activity following the detonation. Stations beyond the northern Nevada border did not detect activity. Figure 3 shows the locations of the samplers with positive results, and Appendix D lists the results for all sampling periods which collected activity attributed to Cabriolet.

The highest integrated gross beta activity at any off-site populated location was 560 μCi-sec/m^3, extrapolated tc the end of collection, at Stone Cabin Ranch, 65 miles and 355° from ground zero. This sample was collected on a temporary sampler operated from 1020 to 1500 hours (through the cloud passage period) on January 26. The integrated activity, extrapolated to the end of collection, at nearby Clark Station was 470 μCi-sec/m^3 on a sample collected between 0730 and 1620 hours. Continued sampling at Clark Station indicated that the integrated gross beta at Stone Cabin Ranch would not have exceeded 565 μCi-sec/m^3 had the sampler there continued to operate.

The locations showing the five highest integrated activities in air collected during cloud passage sampling periods are listed in Table 2. All isotopic results are the sums of the integrated activity on the filter and charcoal cartridge as extrapolated to the end of the collection period.

Samples collected from four routine and four standby air sampling stations in Idaho and Montana did not detect any Cabriolet related activity. All off-site air samples collected after the morning of January 28, 1968, contained background activity.

TABLE 2

Highest $_3$ Integrated Activities
in Air(μCi-sec/m^3) (Charcoal Cartriage and Filter)

LOCATION	SAMPLING TIME On	Off	SAMPLING PERIOD (Hours)	FILTER GROSS BETA	^{131}I	^{132}Te	^{133}I
Stone Cabin Ranch (65 mi, 355°)	1020 (1/26)	1500	4.7	560	6.1	4.0	91
Clark Station (61 mi, 354°)	0730 (1/26)	1620	8.7	470	8.1	10.0	163
Warm Springs (64 mi, 7°)	0900 (1/25-1/26)	1415	28	59	0.31	0.50	6.5
10 mi W of Warm Springs (61 mi, 359°)	1045 (1/26)	1716	6.5	47	0.42	0.43	6.3
Bellehelen Mine (54 mi, 4°)	1025	1235	2.0	27	0.17	0.23	3.3

Milk Sampling

Milk samples were collected from 51 sampling locations in Nevada, Idaho, and Montana, following Cabriolet. Samples from 18 sampling locations in Nevada contained fresh fission products. No milk samples from the other states contained activity attributable to Cabriolet. Milk sample results are listed in Appendix E and the sampling locations are shown in Figures 4 and 5. Sampling stations shown in Figure 4 were sampled until results returned to background. Stations shown in Figure 5 were sampled for a seven-day period following Cabriolet.

Sixteen of the eighteen positive stations were positive during the three-day span of January 28, 29, and 30. Activity in milk from all but

two of the positive locations had returned to minimum detectable levels (20 pCi/liter for isotopes identified by gamma scan) by January 31 (D+5 days). Samples from the Martin Ranch near Eureka, Nevada, were still positive on February 1 and 2, and the Mountain View Ranch samples at Deeth, Nevada, remained positive until February 21.

The highest iodine-131 concentration in milk, 630 pCi/liter, was found on February 8 at Mountain View Ranch. Concentrations of iodine-131 at this location had fluctuated abnormally over the previous week instead of returning to background levels after the initial peak of 550 pCi/liter on January 31. A discussion of these results is presented on page 16 of this report. No children consumed milk from the one lactating cow at this location.

Milk Cow Feed Sampling

Milk cow feed samples were collected from 34 milk sampling locations. Event-related activity was found in only 15 samples collected from six locations in Nevada. Radioiodine was found in milk samples from four of the locations where positive milk cow feed samples were collected. Sampling locations are shown in Figure 6 and the results are listed in Appendix F.

Water and Snow Sampling

Water samples were collected from 43 sampling locations in Nevada. Most of the water samples were from open sources and were collected in conjunction with milk samples. Some puddles were also sampled.

Tungsten-187 was the only isotope detected by gamma scan in the four positive samples collected from the off-site areas. These sources

were open and used for watering livestock only, with the exception of Pinto Creek Ranch near Eureka where the water could also be used for irrigation. There were no positive milk samples collected from the three ranches where livestock water contained tungsten-187. Figure 7 shows the locations of the water samples collected and the results are listed in Appendix G.

One hundred fifty-nine snow samples were collected in Nevada, Idaho, Montana, and North Dakota. Only the surface layer of snow was collected. Locations are shown in Figure 8. Activity attributable to Cabriolet was found in snow samples collected on January 28 and 29 on Highway 93 between Wells, Nevada, and Twin Falls, Idaho, on January 30 on Highway 27 south of Burley, Idaho, and on January 29, between Three Forks and Big Timber, Montana.

Snow samples collected from Bismark, North Dakota, through Circle, Wolf Point, and Great Falls, Montana, on January 28 and 29, did not contain gross gamma activity above background. These samples were mailed to SWRHL arriving about one week after Cabriolet. Positive samples collected from Idaho and the Bozeman, Montana, area were flown by SWRHL aircraft to SWRHL for immediate analysis.

Dosimetry

In addition to the routine distribution of film badges to off-site residents around the Nevada Test Site, 19 off-site residents in the anticipated cloud trajectory were issued one film badge and one TLD each.

No personal film badges showed exposures above the detection limit of 30 mR. One TLD, worn by a resident at Stone Cabin Ranch, showed an

exposure of 8 mR. This was from exposure to cloud passage and to residual radioactivity for 13 days. Another TLD worn by another person at the same location showed no exposure during the same time period. The total exposure computed from ratemeter readings at this location for the period from cloud arrival to one hour after cloud passage was 6 mR.

Plots of exposure rate versus time for the two off-site populated locations with the highest exposures are shown in Figures 9 and 10. These locations are approximately two miles east of the cloud hotline as determined by TLD results.

An arc of TLD's was placed across the predicted effluent trajectory to provide an exposure profile across the cloud. This arc was placed on Highways 6 and 25 at an average distance of 54 miles from ground zero. TLD stations were placed at one-mile intervals across the expected cloud trajectory and at three-mile intervals along the remainder of the arc.

A cross-section of cloud passage exposures along Highways 6 and 25 is plotted in Figure 11. The maximum recorded exposure was 12 mR at 352^{o} and 60 miles from GZ (32 miles east of Tonopah on Highway 6). This included cloud passage plus seven days of residual exposure. A second, smaller exposure of about 1.3 mR above background, appears near the Diablo Maintenance Station. This exposure may be due to a small portion of the cloud which moved eastward from the main cloud, as reported by sampling aircraft. No net exposure at this location was apparent on the dosimeters retrieved seven days after cloud passage (i.e., representing cloud passage plus deposition exposures). The variability in TLD results after one week would tend to mask detection of such small net exposures.

Maximum TLD exposure versus distance both for cloud passage and for cloud passage plus seven days of residual activity is presented in Figure 12. The slopes of the two curves (-2.1) are in agreement.

Downwind exposure patterns from cloud passage plus two to four hours of residual exposure, between ground zero and approximately 65 miles, are shown in Figure 13. The contours are based upon data from TLD's and integrated survey instrument readings.

Whole Body Counting

Whole body counting was performed on 40 SWRHL field personnel associated with Project Cabriolet. Positive counts were found on twelve people, three of whom were in the off-site area. The other nine persons were either in the sampling aircraft or performing duties in contaminated areas on the Nevada Test Site. No off-site residents were whole body counted.

The only isotope identified by whole body counting was ^{187}W. It is possible that ^{133}I may also have been present, since its gamma photopeak would be masked by that of the tungsten. Assuming this to be the case, the spectra from the three off-site monitors were analyzed to determine the maximum amount of ^{133}I which could have been present. This amount was then extrapolated to the time of exposure and the possible doses to the thyroid were estimated as listed below. This does not state the actual dose, but refers only to the maximum dose that could have occurred. No internal exposure above one mrad occurred from the ^{187}W found.

TABLE 3

Maximum ^{133}I Dose Computed from Whole Body Count

LOCATION OF MONITOR	MAXIMUM POSSIBLE ^{133}I DOSE
Stone Cabin Ranch	34 mrads
Clark Station	23 mrads
Monitor immersed in cloud, on Highway 6	26 mrads

Medical and Veterinary Support

No claims of injury to health or property requiring investigation by SWRHL medical or veterinary officers were received following the Cabriolet event.

DISCUSSION

Cloud Travel

Figure 14 shows the off-site area in which Cabriolet-related activity was detected. The effluent traveled to the north-northeast over Nevada, across southeastern Idaho and into Montana.

The movement of the leading edge of the cloud, as indicated by ground monitoring readings and by aerial tracking, is presented in Figure 15. The transport speed out to 60 miles was about 30 miles per hour. From 60 to 225 miles from ground zero, ground monitoring indicates a speed of about 28 miles per hour for the leading edge while aerial tracking at 9,000 and 10,000 feet MSL to a distance of 265 miles shows a speed of about 33 miles per hour. These results would indicate that cloud travel speed was greater at the altitude of aerial tracking than near the ground, as expected.

Airborne Radioactivity

In the following discussion of air sampling the variables used have the constants listed below:

E	= Integrated Activity	$\mu Ci\text{-}sec/m^3$
D	= Distance from GZ	miles
C	= Radioactivity concentration	$\mu Ci/m^3$

T	= Sampler operating time, or cloud passage duration	seconds
A	= Total activity on sample	μCi
R	= Sample flow rate	m^3/second
MDA	= Minimum Detectable Activity	μCi

The integrated gross beta and ^{131}I activities along the hotline at the time of cloud passage were determined from the ASN stations in Nevada (Figure 16). Values for integrated activities in Figure 16 are greater than those listed in Table 2 and Appendix D because they have been extrapolated to cloud passage rather than the end of the collection period. The curves have been drawn slightly above the integrated activity values for Wells because monitoring showed that Wells was east of the cloud hotline. The integrated gross beta activity followed the relationship, $E = 7 \times 10^{9} D^{-3.75}$ as far as Wells (280 miles); for integrated ^{131}I activity $E = 2.4 \times 10^{7} D^{-3.63}$. The steeper slope of the gross beta integrated activity, relative to the ^{131}I activity, is expected because radioactive decay is included in the decreasing activity concentration with distance and time. Since the gross beta activity was decaying faster than the ^{131}I, during the time period involved, a steeper slope is expected.

Besides serving as a measure of exposure to the population involved, the integrated activity serves several other purposes. If an estimate can be made of the duration of cloud passage the average concentration in the cloud passing a selected location along the hotline can be determined from C = E/T. The ability to detect the cloud at a given location is a function of the total activity collected on an air sample and the minimum detectable activity of the analytical system. The total activity collected by a sampler is A = ER. Substituting the MDA for A the required flow rate to detect the cloud at a given location can be found from R = MDA/E.

The following example illustrates the use of these relationships. Bozeman, Montana, at 675 miles from GZ was near the cloud hotline on the basis of snow sample results. The air filters returned from the ASN station at Bozeman showed only background activity at analysis. The 24-hour samples removed on January 27 and 28 were returned through normal mailing channels and received their first gross beta count on February 1. Gross beta activity at the time of the first count was 71 pCi and 34 pCi, respectively, on the two filters. These activities were about 1/5 and 1/12 of that required to perform gamma spectroscopy. Gamma analysis of the charcoal cartridge operated from January 27 to 28 showed only background activity.

The expected integrated gross beta activity at Bozeman is calculated as $E = 7 \times 10^{9} \times 675^{-3.75} = 1.7 \times 10^{-1}$ μCi-sec/m^3. For a sample flow rate of ten cubic feet per minute (4.7×10^{-3} m^3/sec), the activity expected on the filter at the time of cloud passage was:

$$A = ER = 1.7 \times 10^{-1} \times 4.7 \times 10^{-3} = 800 \text{ pCi.}$$

Radioactive decay would have reduced this to approximately 25 pCi at the time of count. Since this is less than the variation in naturally occurring and long-lived activity normally found, the activity was not identifiable as a positive sample.

The expected integrated ^{131}I activity at Bozeman was:

$$E = 2.4 \times 10^{7} \times 675^{-3.63} = 1.3 \times 10^{-3} \text{ } \mu\text{Ci-sec/m}^3.$$

The total activity on the sample would have been:

$$A = ER = 1.3 \times 10^{-3} \times 4.7 \times 10^{-3} = 5.6 \text{ pCi.}$$

This is about 1/10 of the MDA for gamma spectrometry and, therefore, would not have been detected, even if gamma scanned immediately after collection.

Radioiodine in Milk

Figure 17 is a graph of the ^{131}I concentration in milk from Mountain View Ranch near Deeth, Nevada, as a function of time following detonation. The curve does not show the expected decay from the feeding of contaminated hay or from a single uptake and the ensuing elimination. Continuous feeding of contaminated forage to a lactating cow results in an effective half-life for ^{131}I in milk of about three to five days. The data from the cow at Mountain View Ranch show five activity peaks with an effective half-life of about one day for each maximum value. Since the cow was fed baled hay from an open lot containing other livestock, with the hay being removed from the contaminated stack in random fashion, it is postulated that this cow received five separate feedings of contaminated hay.

In order to calculate the ^{131}I dose to a postulated receptor(i.e., a child with a 2 g thyroid, 30% uptake, 1 liter/day consumption) from ingestion of milk at the Mountain View Ranch, the total intake was taken as the sum of the daily ^{131}I results. For those days where no sample was collected, it was arbitrarily assumed that the activity was the same as the previous day. The estimated dose was then calculated as follows:

$$Dose_{Inf} = \frac{K\bar{E}A}{\lambda_{eff}}$$

Where: K = dimensional constant = $51.2 \frac{mrad \cdot g}{MeV \cdot nCi \cdot day}$

$\bar{E}$ = effective beta energy = 0.22 MeV (ICRP II)

λ_{eff} = effective decay constant = $\frac{0.693}{7.6}$ days $^{-1}$ (ICRP II)

A = concentration of iodine in thyroid

$$= \frac{\text{total intake x \% uptake}}{\text{wt thyroid}} = \frac{5.9 \text{ nCi x } 0.30}{2 \text{ g}}$$

Then: Dose_{Inf} = 110 mrad (postulated critical receptor)

Since no children consumed this milk, it would be more reasonable to compute D_{Inf} for a 20 g (adult) thyroid. The estimated dose would then be 11 mrad.

SUMMARY

Results from PHS monitoring and environmental sampling for the Cabriolet event indicate the radioactive cloud released by the detonation remained relatively narrow as it moved northward through Nevada. Activity was not detected in air, milk, or natural vegetation samples collected beyond the northern Nevada border, approximately 330 miles from ground zero. Low levels of residual activity were detected in snow samples collected beyond Three Forks and Big Timber, Montana, approximately 700 miles from ground zero.

The highest gross gamma exposure rate observed during cloud passage at an off-site populated location was 65 mR/h recorded on a permanent exposure rate recorder at Clark Station, Nevada, approximately 61 miles from ground zero. This location was approximately two miles east of the cloud hotline. Residual activity exposure rates at Clark Station were less than 0.1 mR/h seven hours after cloud passage, and were only twice background on the day following the event.

The highest personal TLD exposure to an off-site resident was 8 mR due to cloud passage at Stone Cabin Ranch 65 miles from ground zero. This included cloud passage plus 13 days. A stationary TLD on a fence post near Clark Station also showed 8 mR while a personal TLD worn by a second resident at Stone Cabin showed no exposure above background.

The highest activity concentrations in air were observed at Clark Station and Stone Cabin Ranch, 61 and 65 miles from ground zero. The air sampler at Clark Station showed integrated concentrations of 470 $\mu Ci\text{-}sec/m^3$, gross beta and 8.1 $\mu Ci\text{-}sec/m^3$ of ^{131}I activity at the end of the collection period. The air sampler at Stone Cabin Ranch showed integrated concentrations of 560 $\mu Ci\text{-}sec/m^3$ of gross beta and 6.1 $\mu Ci\text{-}sec/m^3$ of ^{131}I activity at the end of collection. Integrated activity, E, at the time of cloud passage, was found to follow the relationships: $E = 7 \times 10^9 D^{-3.75}$ $\mu Ci\text{-}sec/m^3$ for gross beta particulate activity, and $E = 2.4 \times 10^7 D^{-3.63} \mu Ci\text{-}sec/m^3$ for ^{131}I.

Fresh fission products from the Project Cabriolet effluent were found at 18 milk sampling locations in Nevada. The highest iodine-131 concentration observed in milk was 630 pCi/liter, occurring at the Mountain View Ranch near Deeth, Nevada, in a sample collected on February 8, 1968. Except for this sampling location and the Martin Ranch near Eureka, Nevada, all positive milk samples occurred during a three-day period from January 28 through 30. By February 2 milk samples from Martin Ranch contained no detectable levels of fresh fission product activity, while samples from Mountain View Ranch contained fresh fission products until February 21. Milk samples from Idaho and Montana did not contain activity attributable to the Cabriolet event. The maximum estimated dose from ^{131}I to a hypothetical infant thyroid was 110 mrad at Mountain View Ranch. Since no children were at this location the estimated thyroid dose to the adults drinking the milk was 11 mrad.

Twelve of the forty PHS personnel monitored for internal deposition of radionuclides by the whole body counting facility at the SWRHL were found to have internal deposition of radionuclides attributable to activity from Cabriolet. Nine of these personnel were contaminated either while in tracking aircraft or performing duties in contaminated areas on the Nevada Test Site. Three off-site ground monitors also had internal levels of ^{187}W. Assuming the ^{133}I burdens which could have been present, although masked by the tungsten activity, the highest possible thyroid dose which could have been received from ^{133}I was 34 mrad to a PHS monitor stationed at the Stone Cabin Ranch throughout cloud passage.

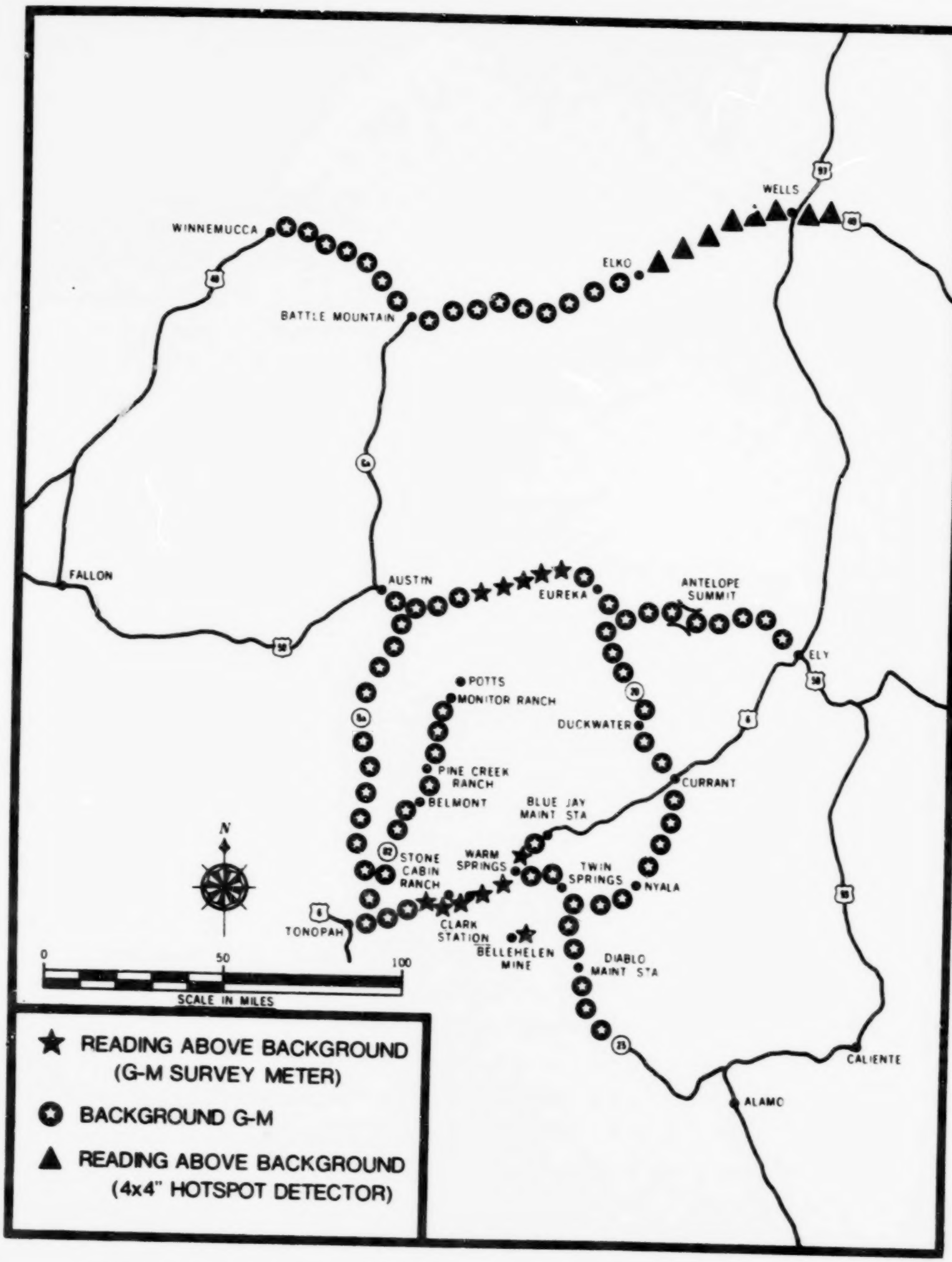

Figure 1. Ground Monitoring Locations by Portable Survey Instruments.

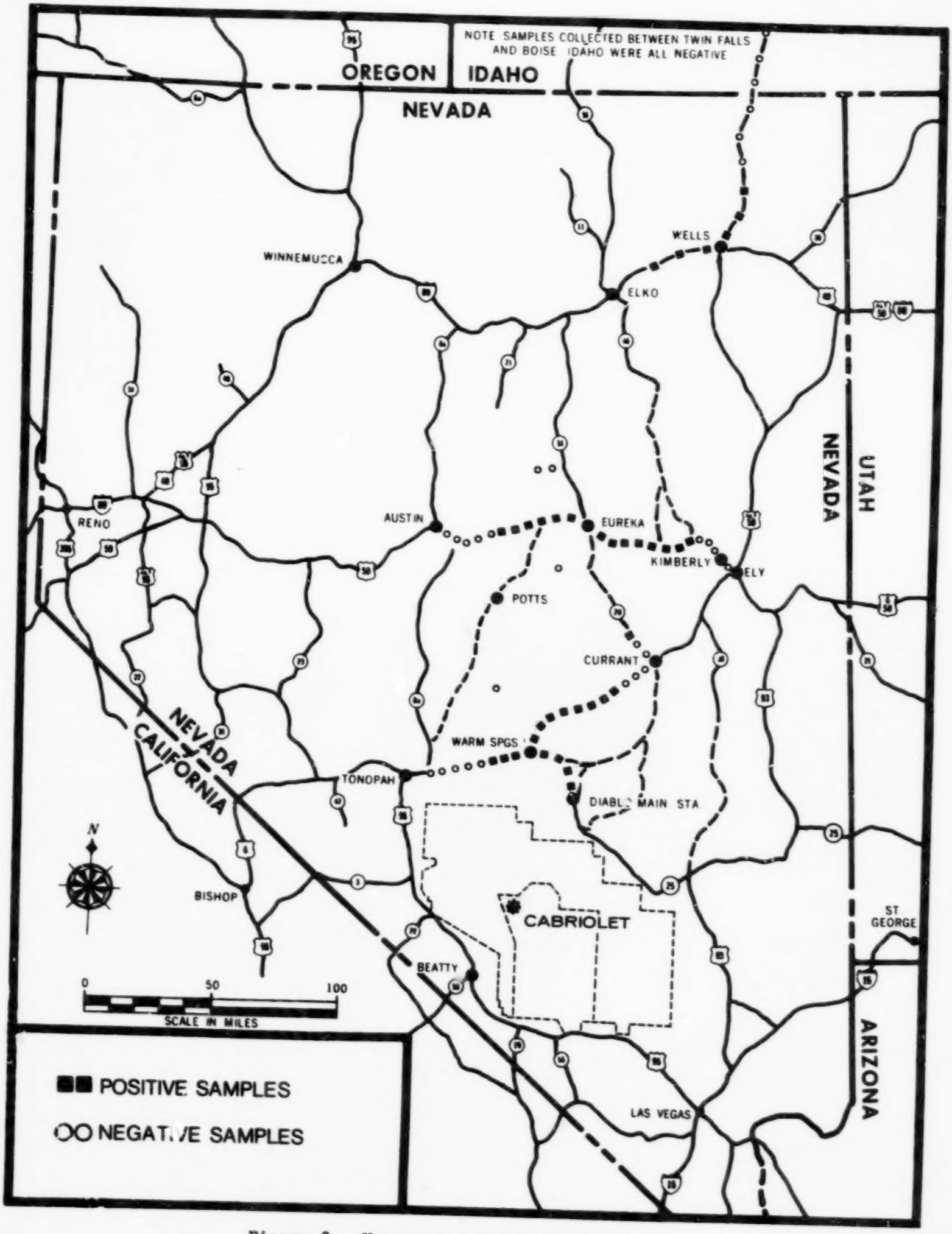

Figure 2. Vegetation Sampling Locations.

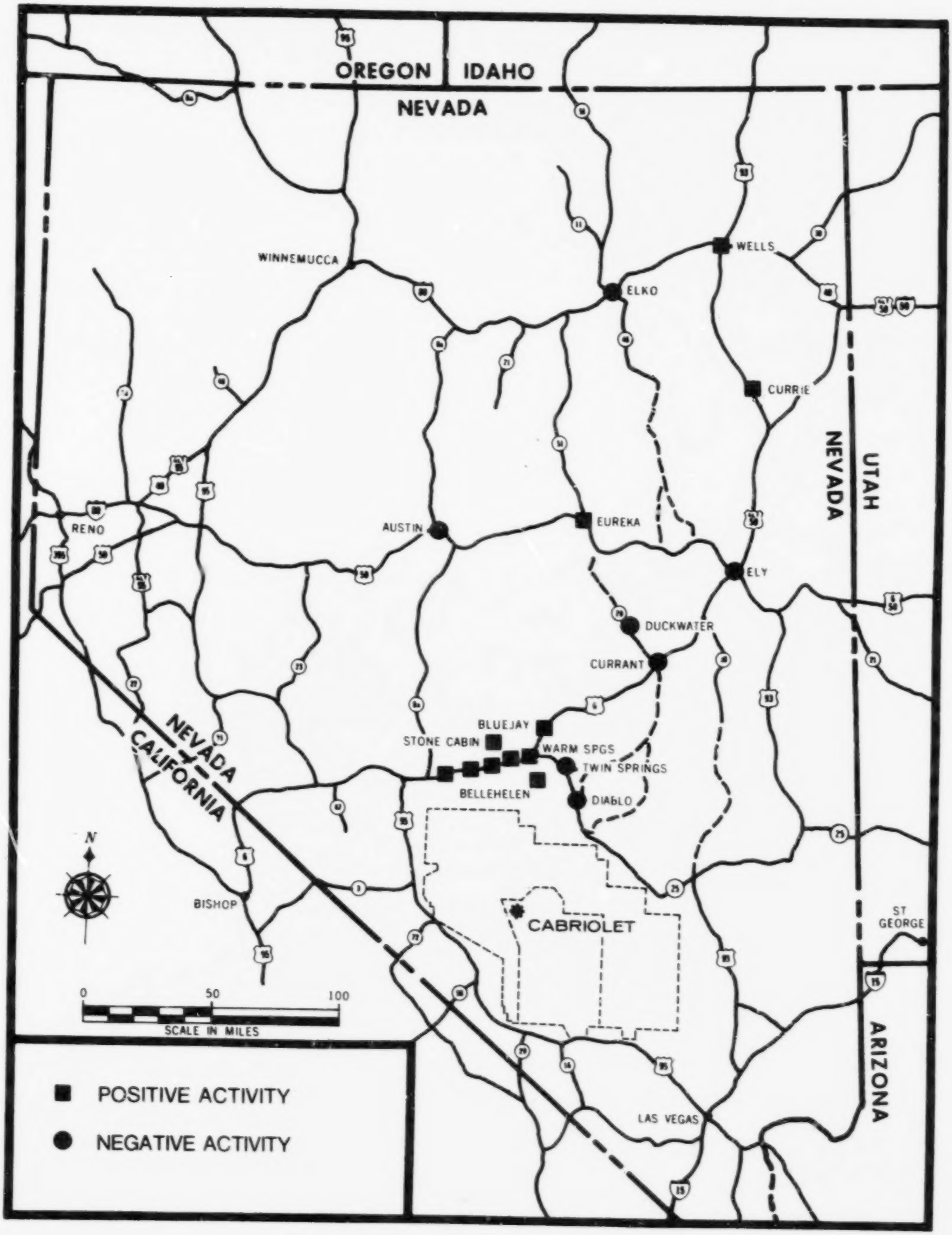

Figure 3. Air Sampling Locations.

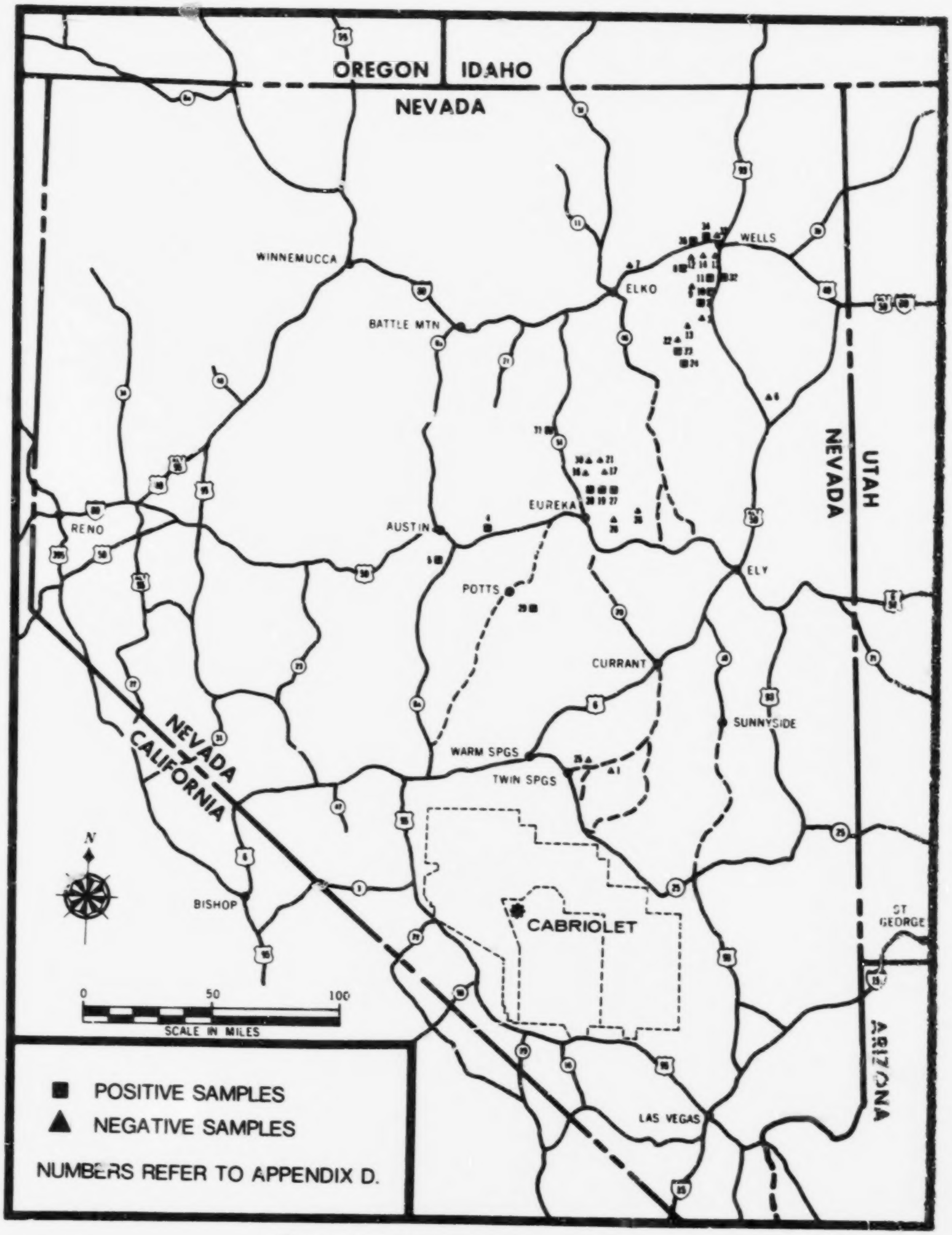

Figure 4. Milk Sampling Locations.

Figure 5. Standby Milk Sampling Locations Sampled for Cabriolet.

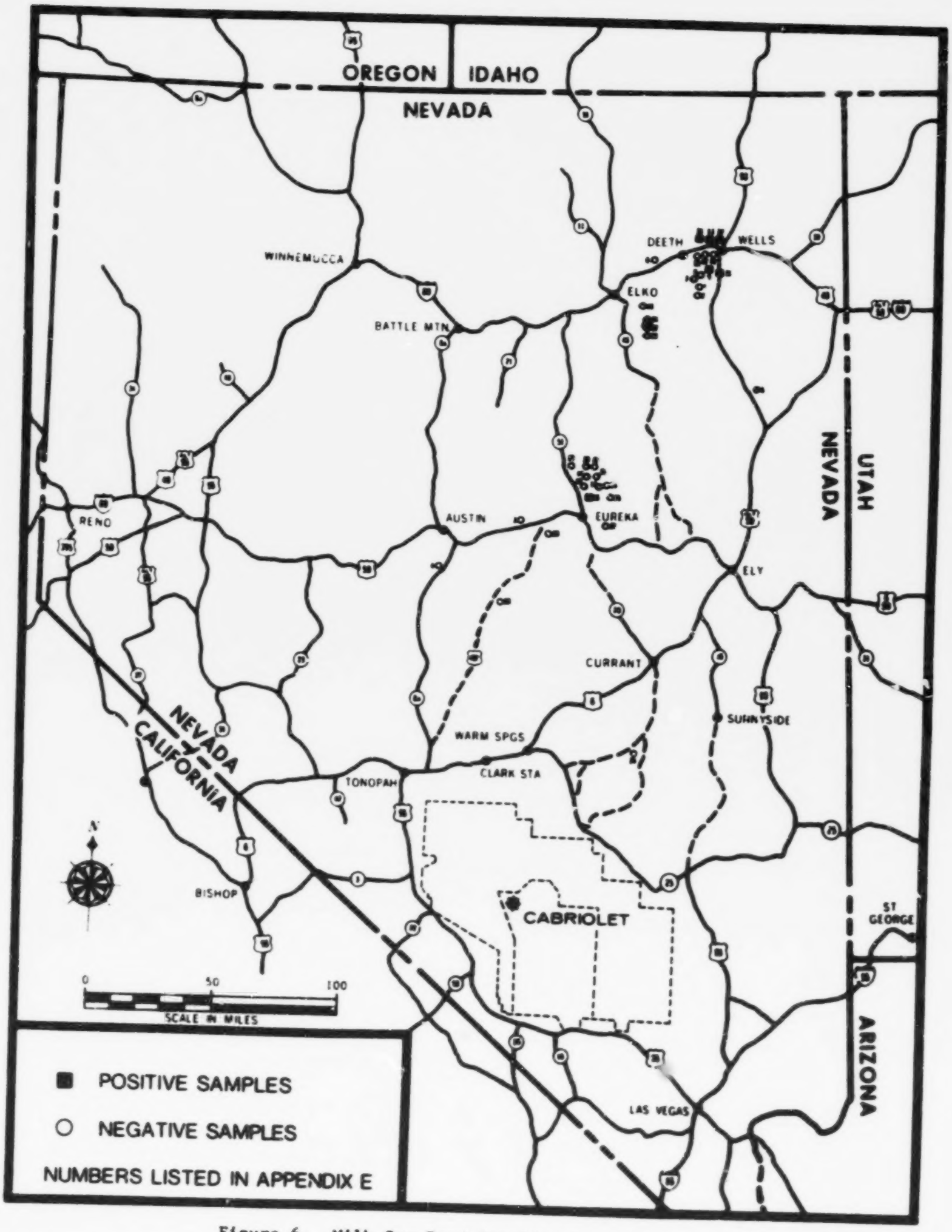

Figure 6. Milk Cow Feed Sampling Locations.

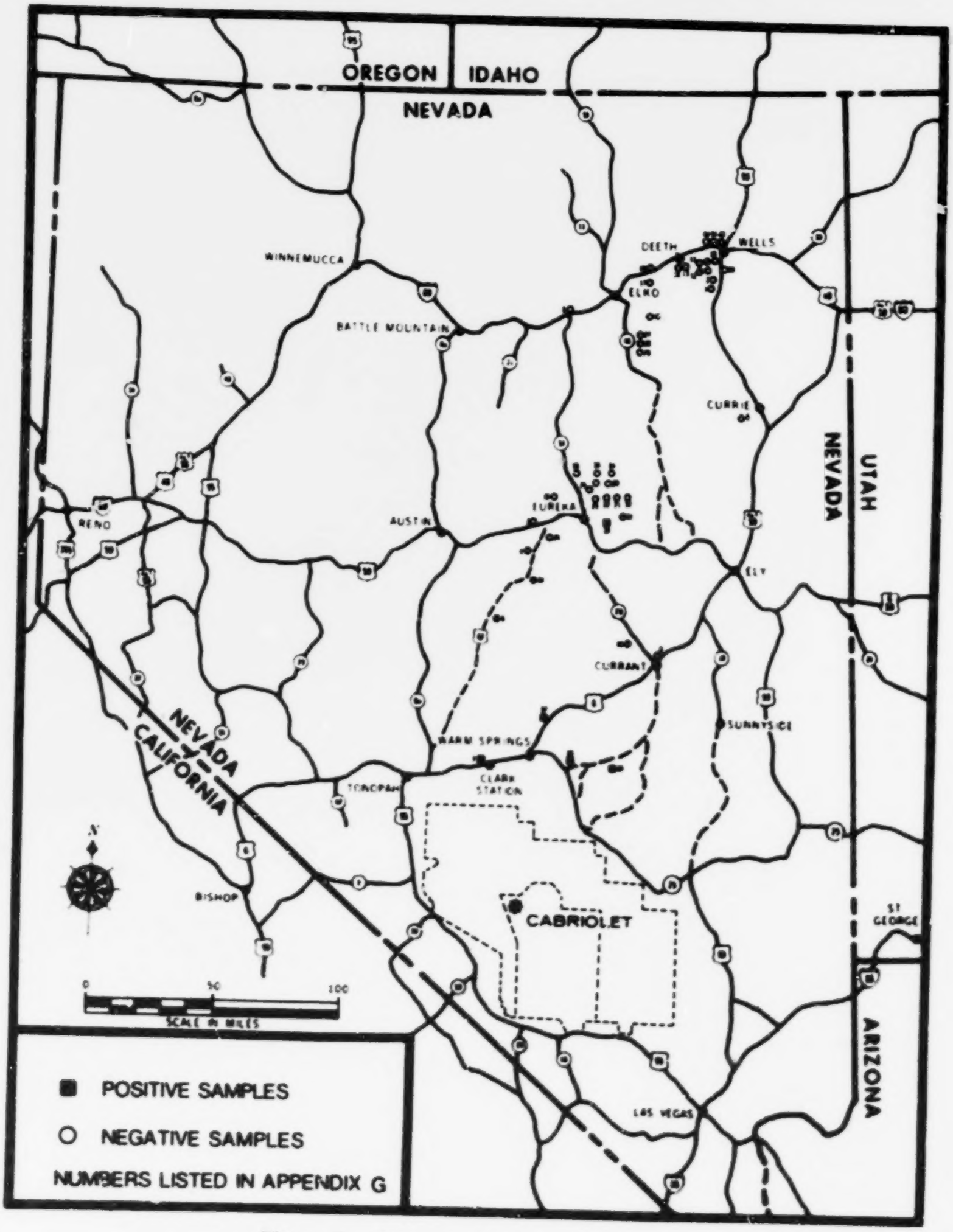

Figure 7. Water Sampling Locations.

Figure 8. Snow Sampling Locations.

Figure 9. Survey Meter Results - Clark Station.

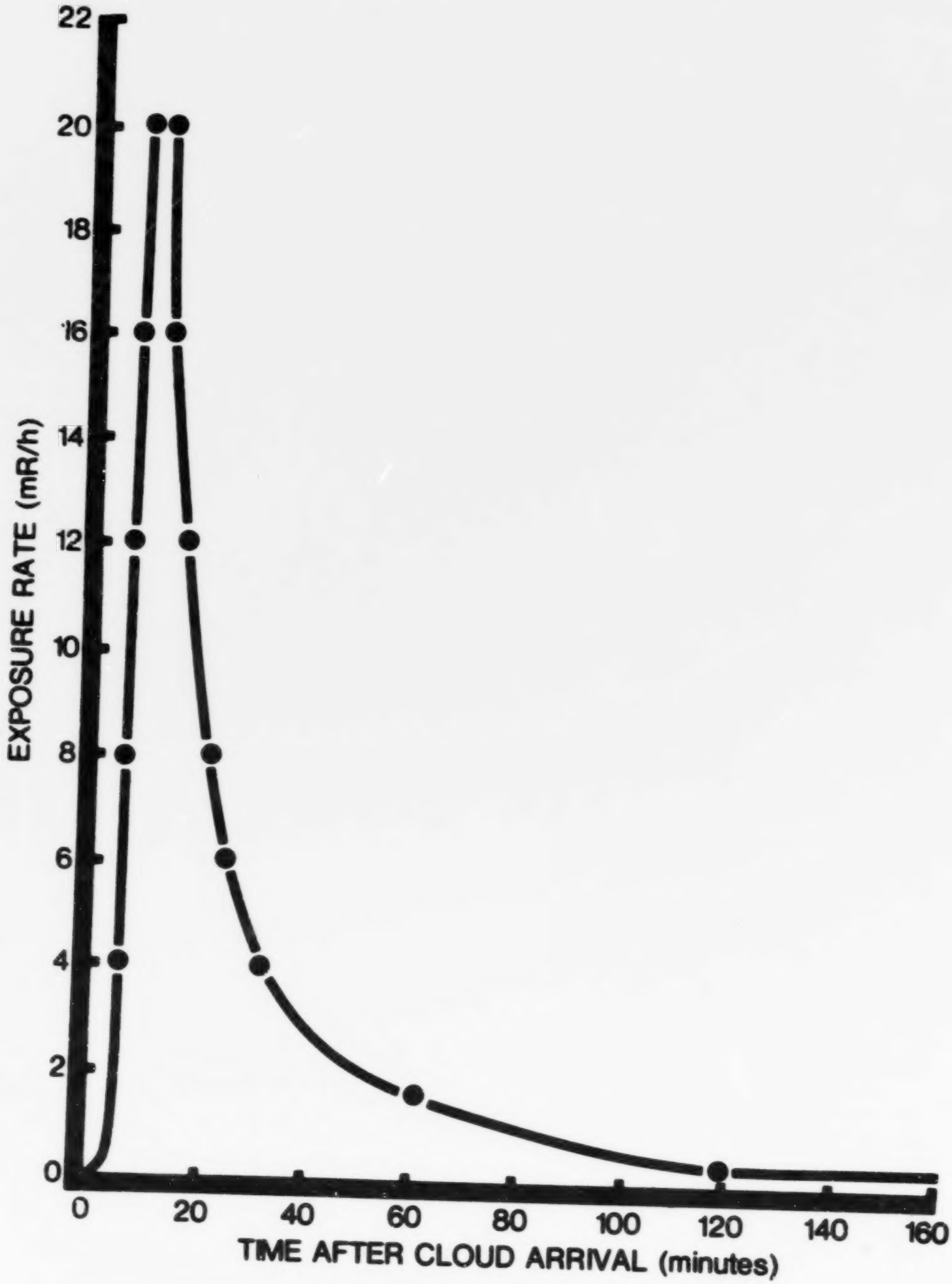

Figure 10. Survey Meter Results - Stone Cabin Ranch.

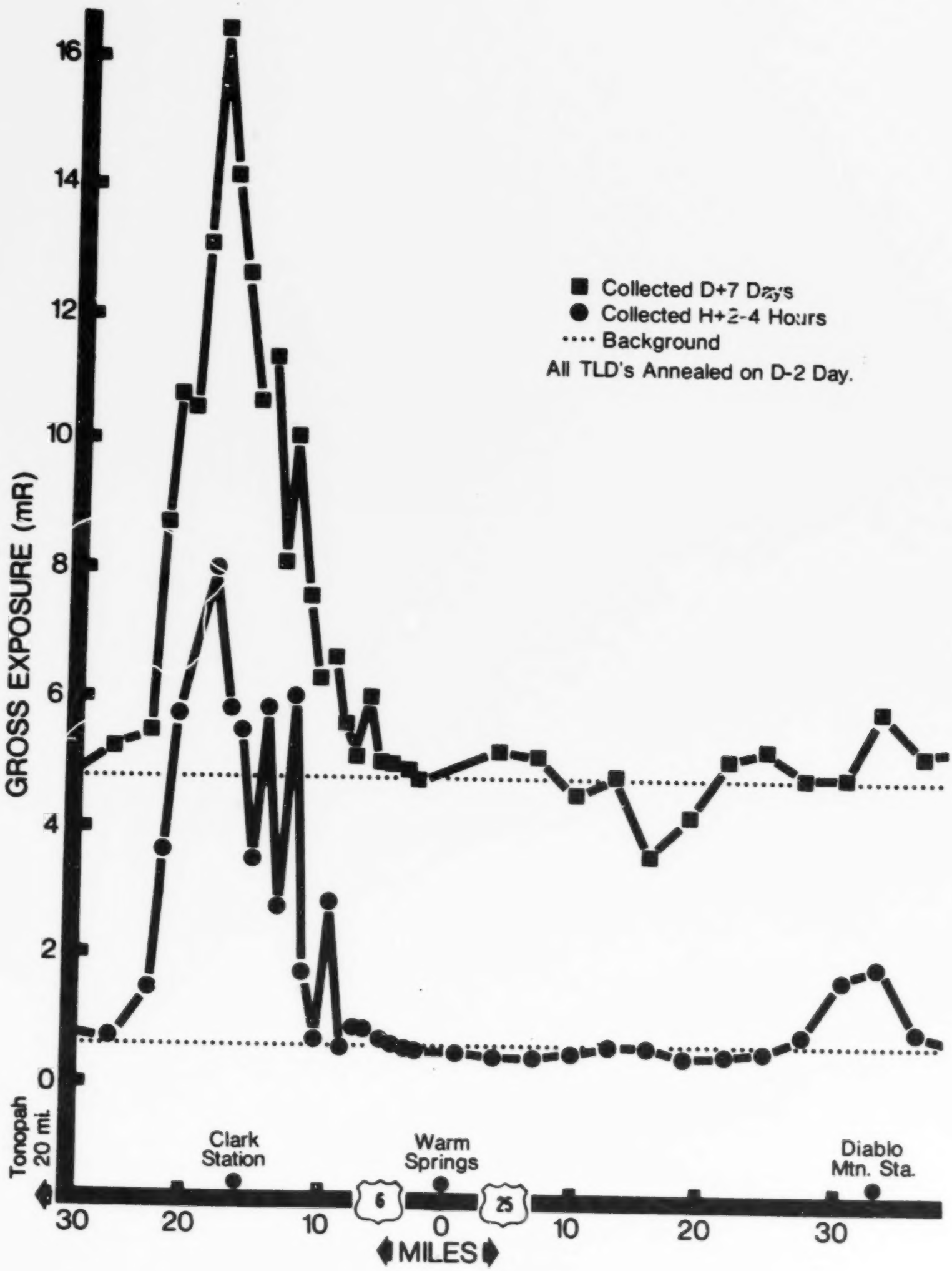

Figure 11. Exposure (TLD's) on Highways 6 and 25.

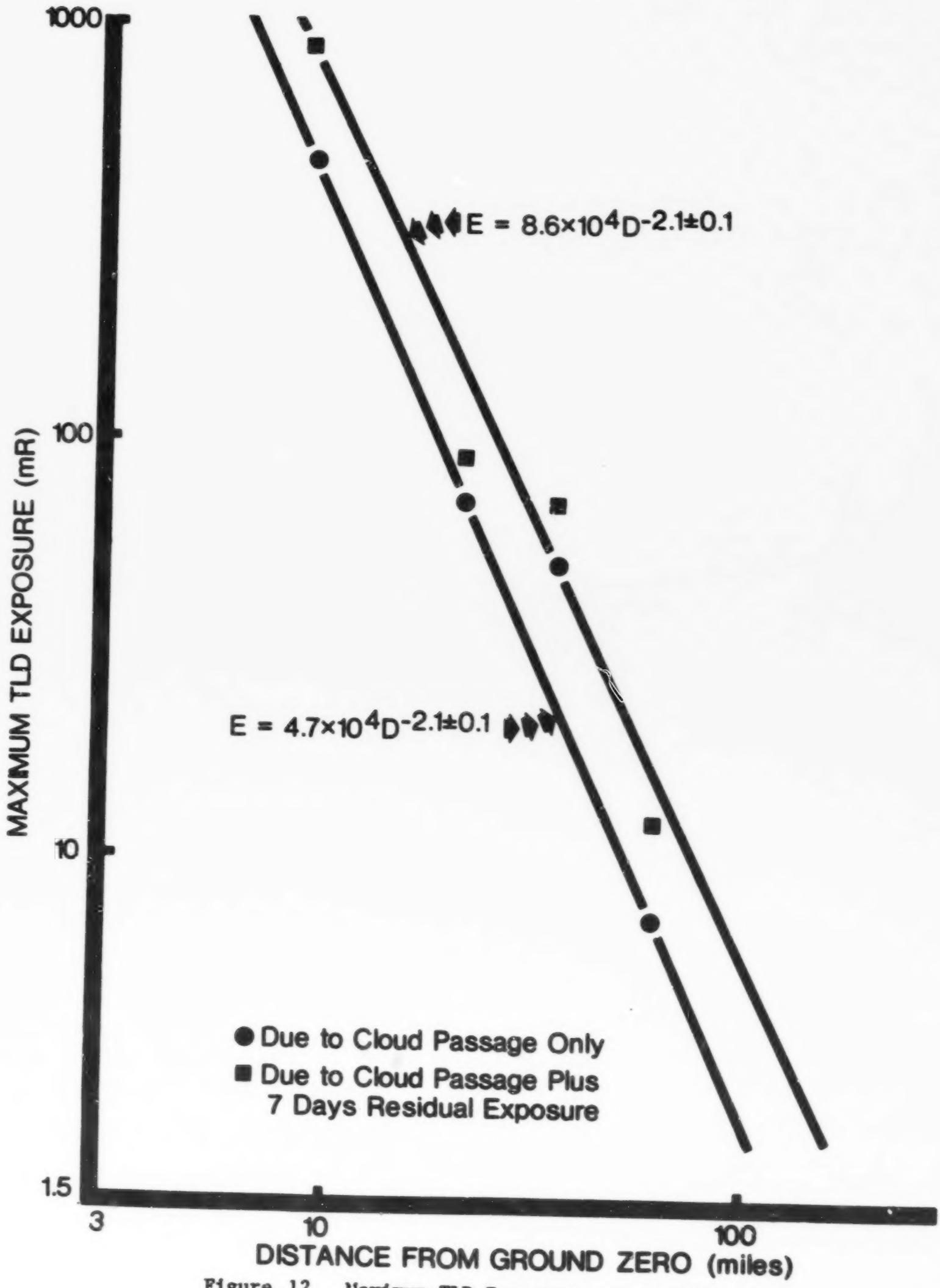

Figure 12. Maximum TLD Exposure versus Distance.

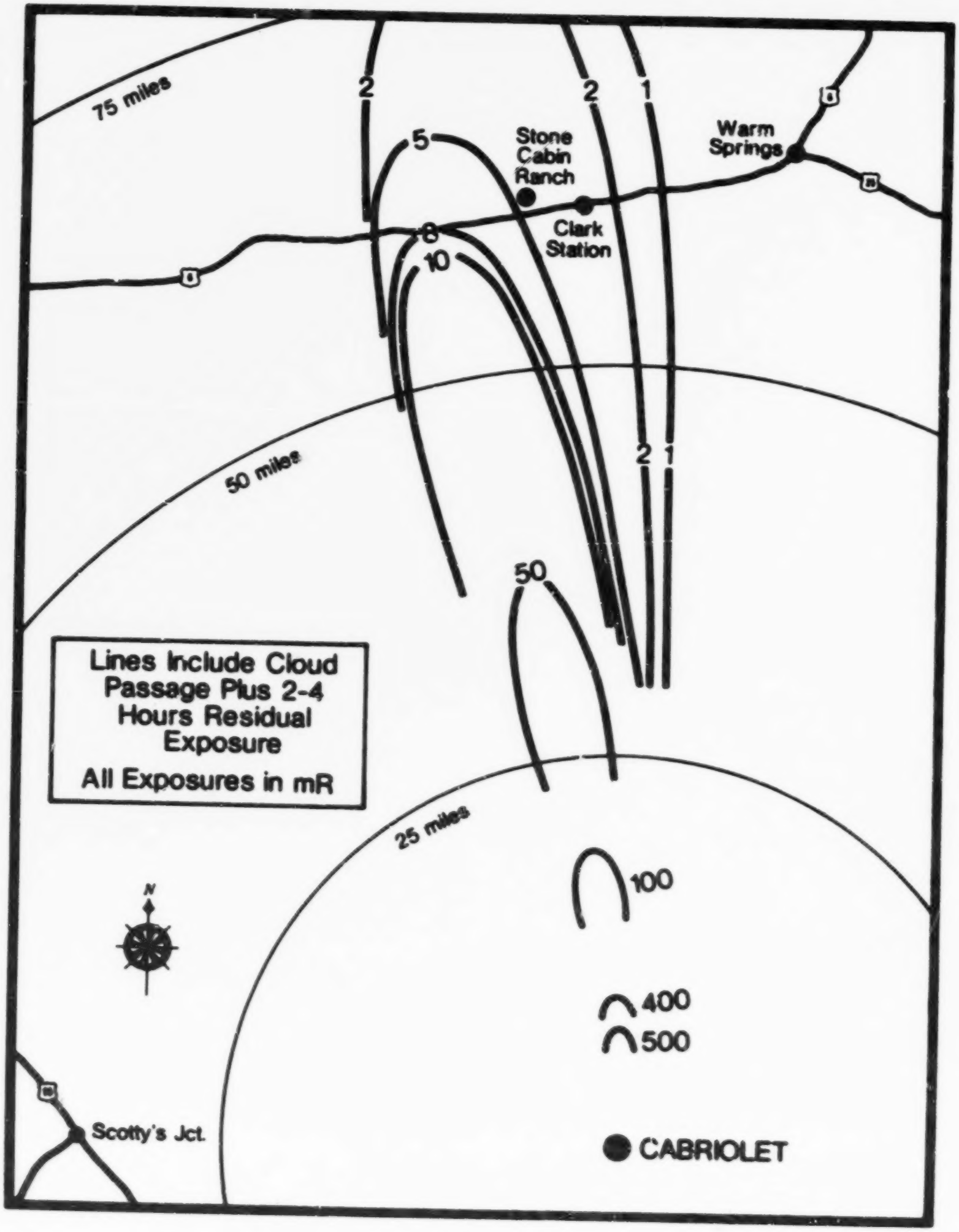

Figure 13. Downwind Exposure Pattern.

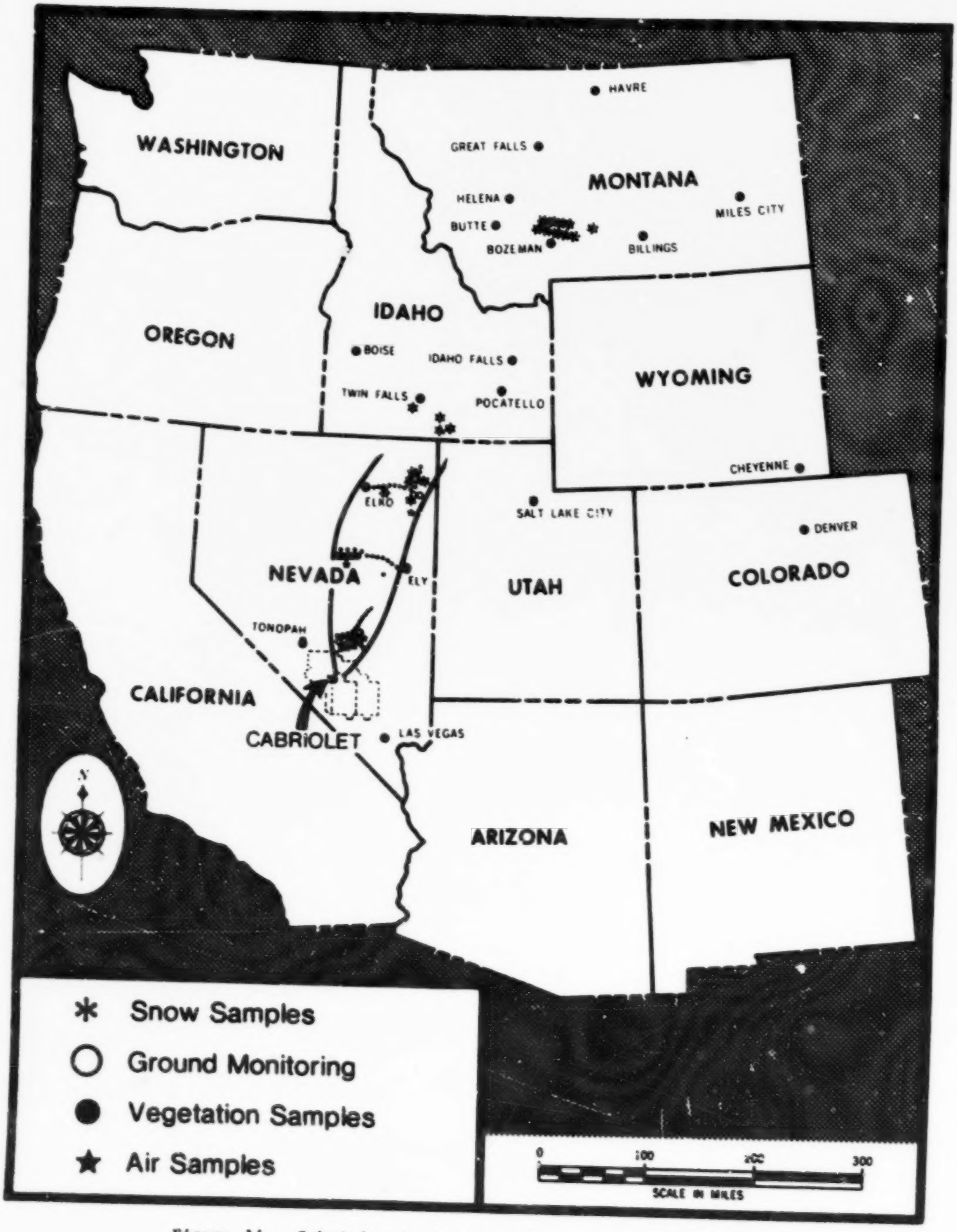

Figure 14. Cabriolet Activity as Detected on the Ground.

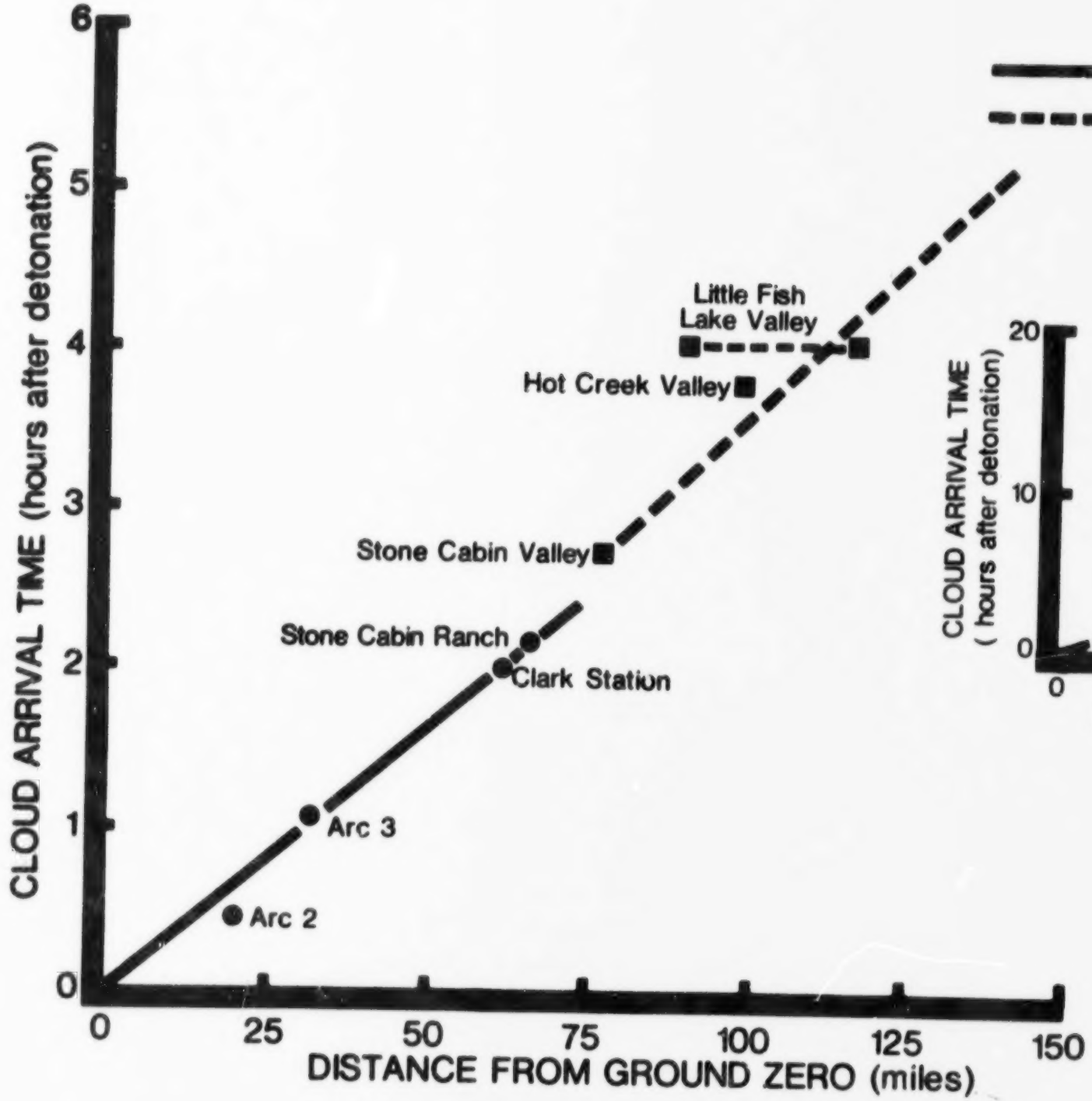

Figure 15. Cloud Transport Speed (Leading Edge).

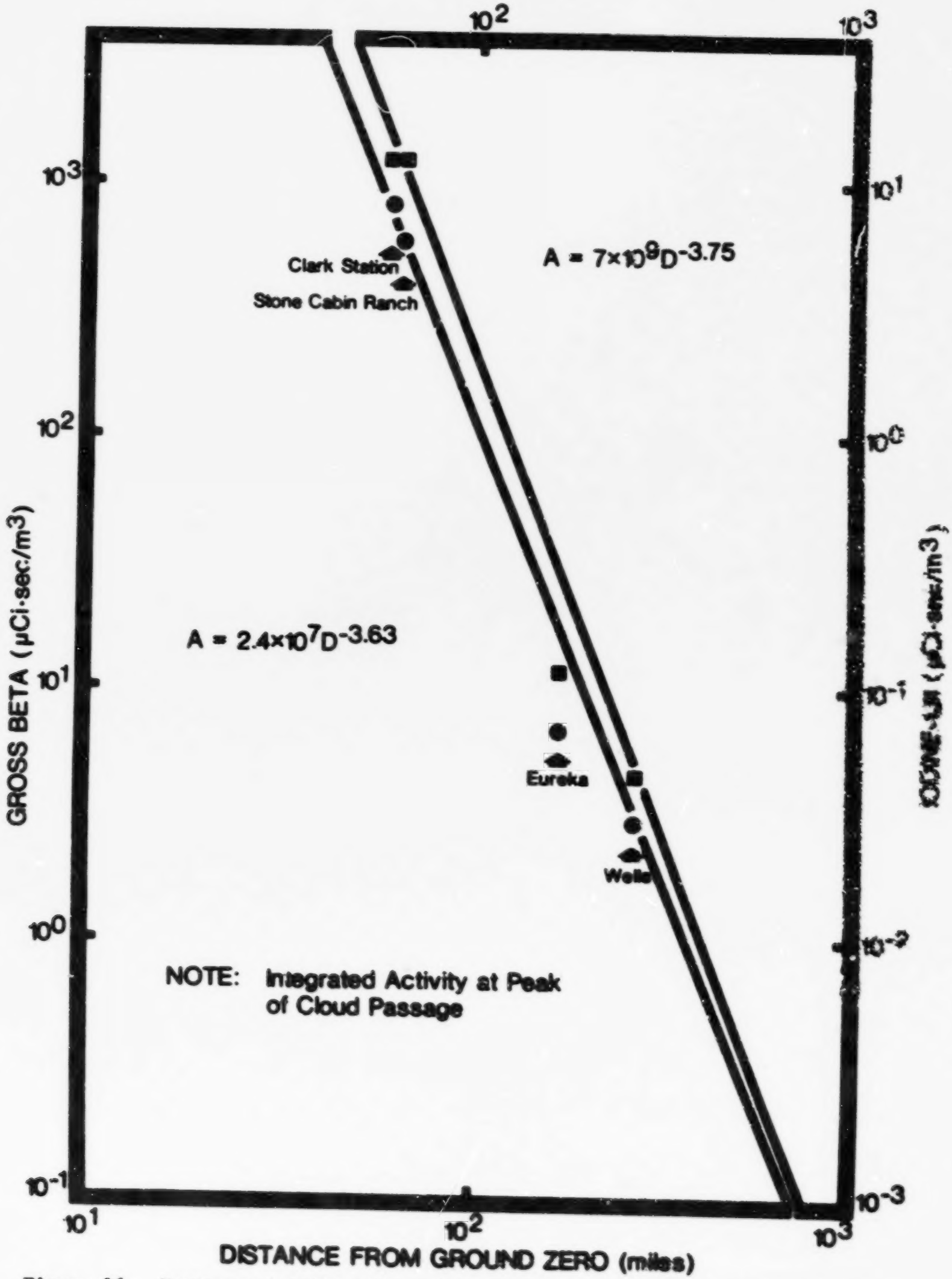

Figure 16. Integrated Iodine-131 and Gross Beta Particulate Concentration.

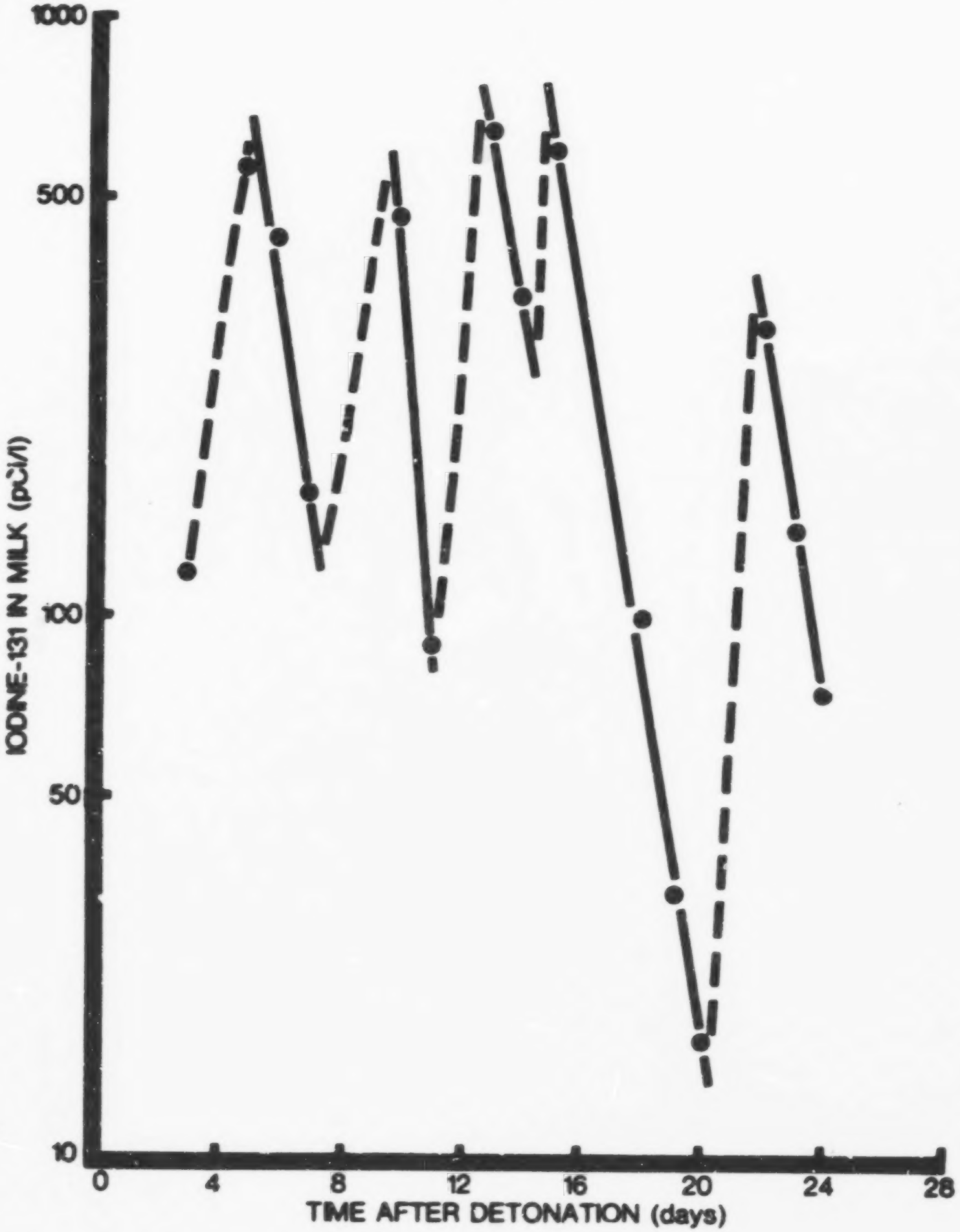

Figure 17. ^{131}I in Milk versus Time (Mountain View Ranch).

LIST OF APPENDICES

		Page
APPENDIX A	Radioassay Techniques	38
APPENDIX B	Summary of Ground Monitoring Results (Gross Gamma at 3 Feet on a GM Survey Instrument)	40
APPENDIX C	Vegetation Sampling Results	44
APPENDIX D	Positive Air Sampling Results	47
APPENDIX E	Milk Sampling Results	51
APPENDIX F	Milk Cow Feed Sampling Results	59
APPENDIX G	Water Sampling Results	63

APPENDIX A. Radioassay Techniques

Descriptions of SWRHL analytical procedures are provided in Chapter 11 of NVO-29, AEC Nevada Operations Office. General analytical procedures used for Cabriolet off-site environmental samples are described in the following paragraphs.

Air Samples

Particulate filters from routine air sampling stations received an initial two-minute gross beta count upon receipt at the laboratory and at five and twelve days after collection. All samples with a beta count rate of over 400 cpm (approximately one pCi/m^3) on the initial count received a gamma spectrum analysis (gamma scan). Any sample having a gross beta count rate of over 150 cpm on the fifth day received a gamma scan if it had not been scanned after the initial gross beta count. Gross beta results were extrapolated to the end of each sampling period. A power function decay relationship was applied to the five and twelve-day counts for any sample with a first count gross beta concentration below 20 pCi/m^3. Filters with initial-count activities greater than 20 pCi/m^3 or from stations in the known cloud trajectory received additional gross beta counts between the first count and the five-day count. Results of these counts were manually extrapolated to the end of the collection period using experimentally derived decay curves for Cabriolet debris.

Charcoal cartridges from the air sampling stations received a 10-minute gamma scan upon receipt at SWRHL. If this scan indicated a net integrated gamma activity greater than 500 cpm, an isotopic identification was made.

Milk Samples

All event-related milk samples collected during the Cabriolet surveillance period were gamma scanned in a 3.5-liter inverted-well beaker for 20 or 40 minutes, depending upon the laboratory sample load and the activity expected in the sample. In most cases, if the gamma scan indicated radioactive iodine and/or barium present in concentrations greater than 30 pCi/l, a radiochemical analysis was performed for strontium-89-90. At least one sample received a strontium-89-90 analysis from most stations regardless of the presence of other radioisotopes.

Water and Snow Samples

Water and snow samples were analyzed for gamma emitters in the same manner as the milk samples. Gross beta analyses were performed by standard evaporation techniques.

Vegetation Samples

All vegetation and cow feed samples were placed in plastic bags upon collection. At the laboratory, they were placed in a second plastic bag and positioned on top of a NaI(Tl) crystal for a gamma scan of 20 or 40 minutes, depending upon the sample load and activity expected. Natural vegetation results were used only as a qualitative parameter to indicate the presence or absence of event-related radioactivity, and the results, therefore, reported only as positive or negative.

All gamma scans were performed with a shielded 4- by 4-inch NaI(Tl) crystal coupled to a multichannel analyzer. Spectral solutions were obtained using an eight-by-eight matrix computer calculation. All isotopic results were extrapolated to collection time (or end of sampling period in the case of air samples).

APPENDIX B. Summary of Ground Monitoring Results
(Gross Gamma at 3 Feet on a GM Survey Instrument)

Location	Time of Max. Reading	Max. Reading (mR/h)	Est. Cloud Arrival Time
Highway 6, Warm Springs to Tonopah Test Range, 1/26/68			
Warm Springs	1125	0.2	1055
10 mi W. Warm Springs	1035	0.2	1027
M&M Mine Turn-off 11 miles W. Warm Springs	1037	0.35	1025
Clark Station 16 miles W. Warm Springs	1009	43	1000
Stone Cabin Ranch 4 miles N. Clark Station	1023	20	1011
26 miles W. Warm Springs	1115	0.3	1104
36 miles W. Warm Springs	--	BKG	--

Re-monitoring Highway 6 after Cloud Passage, 1/26/68

Location	Time of Reading	Exposure Rate (mR/h)
Warm Springs	1812	.04
14 miles E. Clark Station	1807	.04
9 miles E. Clark Station	1800	.03
6 miles E. Clark Station	1746	BKG
3 miles E. Clark Station	1741	.05
Clark Station	1702	.07
Stone Cabin Ranch	1639	.05
Stone Cabin Ranch Turn-off 4 miles W. Clark Station	1652	.05
4 miles W. Clark Station	1700	.05
8 miles W. Clark Station	1710	.04
13 miles W. Clark Station	1723	BKG
17 miles W. Clark Station	1735	BKG
Tonopah	1750	BKG

Re-monitoring Highway 6, Tonopah to Blue Jay Maintenance Station, 1/27/68

Readings at 2-mile intervals were approximately twice the instrument background which was 0.02 mR/h from 28 miles east of Tonopah to the Blue Jay Maintenance Station from 1100 to 1436 hours. All other readings were background. Readings taken from Warm Springs to Diablo Maintenance Station on Highway 25 were at background levels from 1500 to 1800 hours.

Highway 25 and Vicinity, 1/26/68

Bellehelen mine, 10 miles SSW of Warm Springs, 0900 to 1145 hours. Readings above instrument background were observed from 1005 to 1120 hours. The maximum reading was 0.3 mR/h gross gamma at 1020 hours. Levels returned to background by 1120 hours.

Queen City Summit, 0700 to 1600 hours, all background.

Nyala, 1000 to 1045 hours, all background.

Twin Springs, 0930 to 1100 hours, all background.

Reed Ranch, 0700 to 1300 hours, all background.

State Road 82 from Highway 8A junction to Belmont,
Pine Creek Ranch and Monitor Ranch, 1/26/68

Readings taken along State Road 82 from 10 miles NE of the junction with Highway 8A to 10 miles NE of Belmont from 1235 to 1350 hours showed possible low level activity. These levels were less than twice instrument background and may be due to normal background fluctuations. Beyond 10 miles NE of Belmont, the level of activity was background, 1350 to 1500 hours.

Highway 8A from Highway 6 to Highway 50, 1/26/68

Readings taken from 1245 to 1500 hours indicated background levels.

Nyala to Eureka via Currant and Duckwater, 1/26/68

Levels above instrument background were found 20 miles N of Duckwater from 1000 to 1516 hours. These levels were less than twice instrument background and may have been natural background fluctuations.

Highway 50 from Ely to Austin, 1/26/68

Readings above instrument background were found from 14.6 miles W of Eureka to 24.3 miles W of Eureka, between 1328 and 1353 hours. The maximum reading was 0.3 mR/h gross gamma, 20 miles W of Eureka at 1343 hours. Cloud arrival time on Highway 50 was not observed by ground monitors.

Readings above instrument background were found from 9 miles W of Eureka to 36 miles W of Eureka between 1404 and 1511 hours. The maximum reading was 0.06 mR/hr gross gamma, 20 miles W of Eureka at 1430 hours.

Re-monitoring Highway 50, 1/27/68

Measurements made at five mile intervals along Highway 50 from Austin to Antelope Summit, 28 miles E of Eureka, were all background.

Eureka Vicinity, 1/28/68

Readings at the Liberty Livestock Ranch and Conaway Ranch, which are 58 miles N of Eureka, were background.

Highway 40 from Elko to Winnemucca, 1/26/68

Readings taken from Elko to Winnemucca, starting at about 1800 hours, were background.

APPENDIX B (continued)

A deposition pattern was located between Elko and ten miles E of Wells on a survey made between 2130 and 2300 hours. Maximum activity was 40 times background 10 miles W of Wells.

APPENDIX C. Vegetation Sampling Results

Location	Event Related Activity Detected
Hwy 6, 5 mi E Tonopah, Nev.	No
Hwy 6, 10 mi E Tonopah, Nev.	No
Hwy 6, 15 mi E Tonopah, Nev.	No
Hwy 6, 20 mi E Tonopah, Nev.	No
Hwy 6, 25 mi E Tonopah, Nev.	Yes
Hwy 6, 30 mi E Tonopah, Nev.	Yes
Hwy 6, 35 mi E Tonopah, Nev. (Clark Station)	Yes
Hwy 6, 40 mi E Tonopah, Nev.	Yes
Hwy 6, 46 mi E Tonopah, Nev.	Yes
Hwy 6, 50 mi E Tonopah, Nev. (Warm Springs)	Yes
Hwy 6, 5 mi NE Warm Springs, Nev.	Yes
Hwy 6, 10 mi NE Warm Springs, Nev.	Yes
Hwy 6, 15 mi NE Warm Springs, Nev.	Yes
Hwy 6, 20 mi NE Warm Springs, Nev.	Yes
Hwy 6, 25 mi NE Warm Springs, Nev.	Yes
Hwy 6, 30 mi NE Warm Springs, Nev.	Yes
Hwy 6, 35 mi NE Warm Springs, Nev.	Yes
Hwy 6, 40 mi NE Warm Springs, Nev.	Yes
Hwy 6, 45 mi NE Warm Springs, Nev.	No
Hwy 6, 50 mi NE Warm Springs, Nev.	No
Hwy 6, 55 mi NE Warm Springs, Nev.	No
Hwy 6, 60 mi NE Warm Springs, Nev.	No
Currant, Nev.	
Hwy 20, 7 mi NW Currant, Nev.	No
Duckwater, Nev.	
Hwy 25, 5 mi S Warm Springs, Nev.	Yes
Hwy 25, 10 mi S Warm Springs, Nev.	Yes
Hwy 25, 15 mi S Warm Springs, Nev.	Yes
Hwy 25, 20 mi S Warm Springs, Nev.	Yes
Hwy 25, 25 mi S Warm Springs, Nev.	Yes
Hwy 25, 30 mi S Warm Springs, Nev.	Yes

APPENDIX C. (Continued)

Location	Event Related Activity Detected
Diablo Maintenance Station, Nev.	Yes
44 mi NNW of Eureka, Nev. (J.D.Ranch)	No
44 mi NNW of Eureka, Nev. (J.D.Ranch)	No
44 mi NNW of Eureka, Nev. (J.D.Ranch)	No
32 mi SW of Eureka, Nev. (Martin Ranch)	No
Hwy 50, 5 mi E Austin, Nev.	No
Hwy 50, 10 mi E Austin, Nev.	No
Hwy 50, 15 mi E Austin, Nev.	No
Hwy 50, 20 mi E Austin, Nev.	No
Hwy 50, 25 mi E Austin, Nev.	No
Hwy 50, 30 mi E Austin, Nev.	Yes
Hwy 50, 35 mi E Austin, Nev.	Yes
Hwy 50, 40 mi E Austin, Nev.	Yes
Hwy 50, 45 mi E Austin, Nev.	Yes
Hwy 50, 50 mi E Austin, Nev.	Yes
Hwy 50, 55 mi E Austin, Nev.	Yes
Hwy 50, 60 mi E Austin, Nev. (Eureka)	Yes
Hwy 50, 5 mi E Eureka, Nev.	Yes
Hwy 50, 10 mi E Eureka, Nev.	Yes
Hwy 50, 15 mi E Eureka, Nev.	Yes
Hwy 50, 20 mi E Eureka, Nev.	Yes
Hwy 50, 25 mi E Eureka, Nev.	Yes
Hwy 50, 30 mi E Eureka, Nev.	Yes
Hwy 50, 35 mi E Eureka, Nev.	Yes
Hwy 50, 40 mi E Eureka, Nev.	No
Hwy 50, 45 mi E Eureka, Nev. (Moorman Ranch)	No
Hwy 50, 45 mi E Eureka, Nev. (Moorman Ranch)	No
Hwy 50, 50 mi E Eureka, Nev.	No
Hwy 50, 55 mi E Eureka, Nev.	No
Hwy 50, 60 mi E Eureka, Nev.	No

APPENDIX C. (continued)

Location	Event Related Activity Detected
Hwy 50, 65 mi E Eureka, Nev.	No
Hwy 50, 70 mi E Eureka, Nev.	No
Hwy 50, 75 mi E Eureka, Nev. (Ely)	No
Hwy 40, 30 mi W of Wells, Nev.	Yes
Hwy 40, 17 mi W of Wells, Nev.	Yes
Hwy 40, 5 mi W of Wells, Nev.	Yes
Hwy 93, 5 mi N of Wells, Nev.	Yes
Hwy 93, 15 mi N of Wells, Nev.	Yes
Hwy 93, 26 mi N of Wells, Nev.	Yes
Hwy 93, 36 mi N of Wells, Nev.	Yes
Hwy 93, 46 mi N of Wells, Nev.	Yes
Hwy 93, 56 mi N of Wells, Nev.	Yes
Hwy 93, 66 mi N of Wells, Nev.	Yes
Hwy 93, 5 mi N Nevada-Idaho Border	No
Hwy 93, 15 mi N Nevada-Idaho Border	No
Hwy 93, 25 mi N Nevada-Idaho Border	No
Hwy 93, 35 mi N Nevada-Idaho Border	No
Jct 93/30 near Twin Falls, Idaho	No
Buhl, Idaho, 10 mi W Jct 93/30 on Hwy 30	No
Hwy 30, 10 mi W Buhl, Idaho	No
Hwy 30, 18 mi W Buhl, Idaho	No
Hwy 30, 28 mi W Buhl, Idaho	No
Hwy 30, 38 mi W Buhl, Idaho	No
Hwy 30, 48 mi W Buhl, Idaho	No
Hwy 30, 57 mi W Buhl, Idaho	No
Hwy 30, 68 mi W Buhl, Idaho	No
Mountain Home, Idaho	No
Hwy 30, 13 mi W Mountain Home, Idaho	No
Hwy 30, 23 mi W Mountain Home, Idaho	No
Hwy 30, 11 mi E Boise, Idaho	No
Hwy 30, 6 mi E Boise, Idaho	No
Boise, Idaho	No

APPENDIX D. Positive Air Sampling Results

LOCATION	TIME On / Off	DATE On / Off	SAMPLING PERIOD (hrs)		ANALYTICAL RESULTS Concentration (pCi/m^3) ** / Integrated Concentration ($\mu Ci \cdot sec/m^3$)					
					Gross Beta	^{131}I	^{132}Te	^{133}I	^{187}W	^{91}Sr
Blue Jay Maintenance Station, Nevada	0730	26	11.1	PF	160	1.0	1.8	7.3	80	8.4
	1837	26			6.4	0.04	0.07	0.29	3.2	3.4
	1100*	26	7.6	CC	---	1.5	2.2	ND	76	ND
					---	0.04	0.06	--	2.1	--
	1837	26	13.8	PF	6.8	ND	ND	ND	ND	ND
	0800	27			0.34	--	--	--	--	--
				CC	---	ND	ND	ND	ND	ND
					---	--	--	--	--	--
	0800	27	24.2	PF	35	0.8	1.6	ND	ND	ND
	0840	28			3.0	0.07	0.14	--	--	--
				CC	---	ND	ND	ND	ND	ND
					---	--	--	--	--	--
	0840	26	22.7	PF	0.31	ND	ND	ND	ND	ND
	0725	27			0.02	--	--	--	--	--
				CC	---	ND	ND	ND	ND	ND
					---	--	--	--	--	--
Stone Cabin Ranch 4 mi N of Clark Station, Nevada	1020	26	4.7	PF	33,000	290	180	2,500	14,000	9,600
	1500	26			560	4.9	3.0	42	240	160
				CC	---	72	56	2,900	4,900	4,000
					---	1.2	0.95	49	83	68

PF - Particulate Filter
CC - Charcoal Cartridge
ND - Not Detected
* - CC added at 1100
** - The air sampling results are listed showing the top number as the concentration in units of pCi/m^3 and the bottom number as the integrated concentration in $\mu Ci \cdot sec/m^3$. These values are listed in this manner for convenience and not to imply that a ratio exists.

APPENDIX D. (continued)

LOCATION	TIME On / Off	DATE On / Off	SAMPLING PERIOD (hrs)		ANALYTICAL RESULTS Concentration (pCi/m³)** / Integrated Concentration (μCi·sec/m³) Gross Beta	^{131}I	^{132}Te	^{133}I	^{187}W	^{91}Sr
Clark Station,	0730	26	8.7	PF	15,000	150	250	2,000	9,300	6,400
Nevada	1620	26			470	4.7	7.8	63	290	200
				CC	---	110	69	3,300	3,600	1,900
					---	3.4	2.2	100	110	60
	1620	26	15.9	PF	42	0.6	0.6	2.8	47	ND
	0830	27			2.4	0.03	0.03	0.16	2.7	--
				CC	---	ND	ND	ND	ND	ND
					---	--	--	--	--	--
	0830	27	23.8	PF	30	0.7	1.0	3.9	25	ND
	0800	28			2.6	0.06	0.08	0.33	2.1	--
				CC	---	ND	ND	ND	ND	ND
					---	--	--	--	--	--
10 mi W of Clark	1005	26	7.5	PF	5.4	ND	ND	0.2	ND	ND
Station, Nevada	1735	27			0.15	--	--	0.005	--	--
				CC	---	0.1	ND	0.1	ND	ND
					---	0.003	--	0.003	--	--
20 mi W of Clark	1042	26	7.7	PF	160	1.8	2.8	24	89	7.0
Station, Nevada	1800	26			4.4	0.05	0.08	0.66	2.5	0.19
				CC	---	ND	ND	19	34	ND
					---	--	--	0.53	0.94	--

PF - Particulate Filter
CC - Charcoal Cartridge
ND - Not Detected
** - See footnote on page 47

APPENDIX D. (continued)

LOCATION	TIME On / Off	DATE On / Off	SAMPLING PERIOD (hrs)		ANALYTICAL RESULTS Concentration (pCi/m^3) ** Integrated Concentration ($\mu Ci \cdot sec/m^3$)					
					Gross Beta	^{131}I	^{132}Te	^{133}I	^{187}W	^{91}Sr
Currie, Nevada	0700	26	24.7	PF	3.1	0.3	0.3	2.4	28	ND
	0700	27			0.81	0.03	0.03	0.21	2.5	--
Diablo Maintenance Station, Nevada	0645	26	24.6	PF	6.5	ND	ND	ND	6.0	ND
	0656	27			0.58	--	--	--	0.05	--
				CC	---	ND	ND	ND	ND	ND
					---	--	--	--	--	--
Eureka, Nevada	1200	26	19	PF	65	1.0	1.4	19	42	ND
	0700	27			4.4	0.07	0.10	1.3	2.9	--
				CC	---	ND	ND	ND	ND	ND
					---	--	--	--	--	--
Fallini's Ranch (Twin Springs) Nevada, 10 mi E of Warm Springs	0930	26	15.8	PF	1.8	ND	ND	ND	1.5	ND
	1030	27			0.10	--	--	--	0.08	--
				CC	---	ND	ND	ND	ND	ND
					---	--	--	--	--	--
Warm Springs, Nevada	0900	25	28	PF	590	2.7	4.0	53	180	84
	1415	26			59	0.27	0.40	5.3	18	8.5
				CC	---	0.4	1.0	12	22	ND
					---	0.04	0.10	1.2	2.2	--
	1415	26	6.5	PF	540	4.1	6.6	42	300	ND
	2045	27			13	0.10	0.15	0.98	7.0	--
				CC	---	83	69	240	210	ND
					---	1.9	1.6	5.6	4.9	--

PF - Particulate Filter
CC - Charcoal Cartridge
ND - Not Detected
** - See footnote on page 47

APPENDIX D. (continued)

LOCATION	TIME On Off	DATE On Off	SAMPLING PERIOD (hrs)		ANALYTICAL RESULTS Concentration (pCi/m³) ** Integrated Concentration (μCi·sec/m³) Gross Beta	^{131}I	^{132}Te	^{133}I	^{137}W	^{91}Sr
Warm Springs, Nevada (cont)	2045	26	12.3	PF	19	0.2	ND	0.8	12	ND
	0900	27			0.84	0.009	--	0.04	0.53	--
				CC	---	0.2	ND	3.0	12	ND
					---	0.009	--	0.04	0.53	--
Bellehelen Mine	1025	26	2.0	PF	3,800	18	29	290	1,400	270
10 mi SSW of Warm	1235	26			27	0.13	0.21	2.1	10	1.9
				CC	---	5.5	2.8	160	850	ND
					---	0.04	0.02	1.2	6.1	--
10 mi W of Warm Springs, Nevada	1045	26	6.5	PF	2,000	11	18	120	840	130
	1715	26			47	0.26	0.42	2.8	20	3.0
				CC	---	6.7	0.4	150	330	ND
					---	0.16	0.009	3.5	7.7	--
Wells, Nevada	1701	25	24.5	PF	2.9	ND	ND	ND	ND	ND
	1731	26			0.26	--	--	--	--	--
	1733	26	23.8	PF	19	0.4	0.4	7.5	17	ND
	1706	27			1.6	0.03	0.03	0.64	1.4	--

PF - Particulate Filter
CC - Charcoal Cartridge
ND - Not Detected
** - See footnote on page 47

APPENDIX E. Milk Sampling Results

FIGURE AND NUMBER	LOCATION Azimuth and Distance	DATE MILKED	ISOTOPIC RESULTS (pCi/l) ^{131}I	^{133}I	^{137}Cs	^{89}Sr	^{90}Sr
4-1	Simpson's Ranch Adaven, Nevada 28°, 76 mi	1/25	ND	ND	19	ND	7
2	Murphy Ranch	1/29	30	ND	90	5	12
	Arthur, Nevada	1/29	ND	ND	30	NC	NC
	12°, 256 mi	1/30	ND	ND	ND	7	10
		1/31	ND	ND	25	NC	NC
		2/1	ND	ND	ND	NC	NC
3	Neff Ranch	1/29	ND	ND	35	NC	NC
	Arthur, Nevada	1/30	ND	ND	ND	14	11
	11°, 250 mi	1/31	ND	ND	15	NC	NC
		2/1	ND	ND	20	NC	NC
4	Dry Creek Ranch	1/28	ND	ND	20	6	48
	Austin, Nevada	1/29	50	ND	80	5	18
	350°, 164 mi	1/30	ND	ND	20	NC	NC
		1/31	ND	ND	ND	ND	24
		2/1	ND	ND	ND	NC	NC
5	Young's Ranch	1/27	ND	ND	ND	ND	7
	Austin, Nevada	1/27	ND	ND	ND	7	6
	343°, 149 mi	1/28	50	210	40	6	7
		1/29	ND	ND	ND	ND	9
		1/30	ND	ND	ND	NC	NC
		1/31	ND	ND	20	ND	6
		2/1	ND	ND	ND	NC	NC
		2/2	ND	ND	ND	NC	NC
6	Bill Lear Ranch	1/28	ND	ND	ND	ND	6
	Currie, Nevada	1/29	ND	ND	30	ND	6
	20°, 230 mi						
7	Devil's Gate Ranch Deeth, Nevada 7°, 282 mi	1/28	ND	ND	ND	ND	6
8	Friendly Ranch Deeth, Nevada 10°, 271 mi	1/29	ND	ND	ND	9	11
9	Lane Ranch	1/29	30	ND	ND	14	8
	Deeth, Nevada	1/30	ND	ND	ND	18	9
	10°, 271 mi	1/31	ND	ND	ND	15	13
		2/1	ND	ND	ND	NC	NC
		2/2	ND	ND	ND	NC	NC

NC - No Strontium Analysis Performed ND - Not Detected

APPENDIX E. (continued)

FIGURE AND NUMBER	LOCATION Azimuth and Distance	DATE MILKED	ISOTOPIC RESULTS (pCi/l) ^{131}I	^{133}I	^{137}Cs	^{89}Sr	^{90}Sr
4-10	Lotspeich Ranch	1/28	ND	ND	10	17	7
	Deeth, Nevada	1/29	60	60	ND	34	ND
	10°, 374 mi	1/30	45	30	ND	18	9
		1/31	ND	ND	ND	8	10
		2/1	ND	ND	ND	NC	NC
		2/2	ND	ND	ND	NC	NC
		2/3	ND	ND	ND	NC	NC
		2/4	ND	ND	ND	NC	NC
11	Mountain View Ranch	1/29	120	640	40	28	8
	Deeth, Nevada	1/31	550	220	45	58	8
	11°, 274 mi	2/1	320	60	20	53	10
		2/2	160	30	15	44	11
		2/5	430	90	46	42	8
		2/6	90	ND	ND	NC	NC
		2/8	630	20	80	13	6
		2/9	370	ND	ND	NC	NC
		2/10	590	280	37	NC	NC
		2/13	100	ND	ND	NC	NC
		2/14	35	ND	ND	NC	NC
		2/15	20	ND	ND	42	14
		2/16	ND	ND	27	43	9
		2/17	350	ND	23	53	16
		2/18	140	ND	ND	107	11
		2/19	75	ND	28	77	12
		2/21	ND	ND	ND	NC	NC
		2/22	ND	ND	ND	NC	NC
12	River Ranch	1/29	70	130	ND	33	2
	Deeth, Nevada	1/30	ND	ND	35	NC	NC
	9°, 270 mi	1/31	ND	ND	ND	27	6
		2/1	160	90	ND	10	9
		2/2	ND	ND	ND	NC	NC
		2/5	ND	ND	ND	NC	NC
13	Winchell Ranch	1/30	ND	ND	ND	NC	NC
	Deeth, Nevada	1/31	ND	ND	20	14	9
	11°, 275 mi	2/1	ND	ND	15	NC	NC
		2/2	ND	ND	20	NC	NC
14	Anchor S. Ranch	1/27	ND	ND	ND	ND	5
	Elko, Nevada	1/30	ND	ND	ND	NC	NC
	6°, 262 mi	1/31	ND	ND	ND	6	3

NC - No Strontium Analysis Performed ND - Not Detected

APPENDIX E. (continued)

FIGURE AND NUMBER	LOCATION Azimuth and Distance	DATE MILKED	ISOTOPIC RESULTS (pCi/l) ^{131}I	^{133}I	^{137}Cs	^{89}Sr	^{90}Sr
4-15	LDS Welfare Ranch	1/30	ND	ND	15	ND	4
	Elko, Nevada	2/1	ND	ND	ND	NC	NC
	6°, 239 mi						
16	Conaway Ranch	1/28	ND	ND	ND	ND	6
	Eureka, Nevada	1/28	ND	ND	ND	ND	6
	4°, 176 mi	1/30	ND	ND	ND	NC	NC
		1/31	ND	ND	ND	ND	7
17	Labarry Ranch	1/27	ND	ND	ND	9	3
	Eureka, Nevada	1/28	ND	ND	16	5	2
	6°, 181 mi	1/30	ND	ND	ND	ND	4
		1/31	ND	ND	ND	ND	1
		2/1	ND	ND	ND	NC	NC
18	Liberty Livestock	1/28	ND	ND	ND	6	9
	Ranch	1/29	ND	ND	ND	ND	6
	Eureka, Nevada	1/30	ND	80	ND	NC	NC
	4°, 174 mi	1/31	ND	ND	ND	6	6
		2/1	ND	ND	ND	NC	NC
19	Palmore Ranch	1/28	ND	30	ND	ND	6
	Eureka, Nevada	1/29	ND	40	ND	ND	5
	5°, 181 mi	1/30	ND	ND	ND	NC	NC
		1/31	ND	ND	ND	ND	5
		2/1	ND	ND	ND	NC	NC
		2/5	ND	ND	ND	NC	NC
20	Pollard Ranch	1/29	40	60	ND	ND	6
	Eureka, Nevada	1/30	30	ND	ND	6	4
	6°, 184 mi	1/31	20	ND	ND	ND	5
		2/1	ND	ND	ND	NC	NC
		2/2	ND	ND	ND	NC	NC
		2/4	ND	ND	ND	NC	NC
		2/5	ND	ND	ND	NC	NC
21	Thompson Ranch	1/28	ND	ND	10	ND	6
	Eureka, Nevada	1/29	ND	ND	ND	ND	3
	5°, 190 mi	1/30	ND	ND	25	NC	NC
		1/31	ND	ND	20	ND	5
		2/1	ND	ND	ND	NC	NC
		2/2	ND	ND	ND	NC	NC

NC - No Strontium Analysis Performed ND - Not Detected

APPENDIX E. (continued)

FIGURE AND NUMBER	LOCATION Azimuth and Distance	DATE MILKED	ISOTOPIC RESULTS (pCi/l) ^{131}I	^{133}I	^{137}Cs	^{89}Sr	^{90}Sr
4-22	Barnes Ranch	1/29	ND	ND	ND	NC	NC
	Jiggs, Nevada	1/31	ND	ND	ND	5	5
	8°, 224 mi	2/1	ND	ND	ND	NC	NC
23	Rose Ranch	1/30	45	ND	60	6	8
	Jiggs, Nevada	1/31	ND	ND	ND	8	7
	7°, 237 mi	2/1	ND	ND	ND	NC	NC
24	Zunino Ranch	1/29	ND	ND	ND	ND	16
	Jiggs, Nevada	2/1	ND	120	ND	ND	18
	7°, 229 mi	2/7	ND	ND	ND	5	16
25	Sharp's Ranch	1/23	ND	ND	22	ND	8
	Nyala, Nevada	1/27	ND	ND	16	ND	8
	21°, 80 mi						
26	Circle Ranch	1/27	ND	ND	ND	8	6
	Pancake Summit,	1/28	ND	ND	50	7	6
	Nevada	1/29	ND	ND	ND	ND	10
	8°, 169 mi	1/30	ND	ND	40	NC	NC
		1/31	ND	ND	40	ND	7
		2/1	ND	ND	80	NC	NC
		2/2	ND	ND	100	NC	NC
27	Cold Creek Ranch	1/27	110	230	ND	7	4
	Pancake Summit,	1/28	ND	ND	ND	7	5
	Nevada	1/29	ND	ND	ND	ND	4
	7°, 187 mi	1/30	ND	ND	ND	ND	9
		1/31	ND	ND	ND	ND	7
		2/1	ND	ND	ND	NC	NC
		2/2	ND	ND	15	NC	NC
28	Pinto Creek Ranch	1/28	ND	ND	ND	ND	3
	Pancake Summit,	1/29	ND	ND	ND	5	1
	Nevada	1/30	ND	ND	ND	NC	NC
	7°, 160 mi	1/31	ND	ND	ND	ND	4
		2/1	ND	ND	ND	NC	NC
		2/2	ND	ND	ND	NC	NC
29	Martin Ranch	1/26	ND	ND	14	6	5
	Potts, Nevada	1/27	100	1100	60	16	5
	356°, 136 mi	1/28	110	640	50	11	7
		1/29	80	140	20	14	6
		1/30	ND	ND	ND	6	9
		1/31	40	ND	ND	7	6
		2/1	50	ND	ND	8	6
		2/3	ND	ND	ND	NC	NC
		2/4	ND	ND	ND	NC	NC
		2/5	ND	ND	ND	NC	NC

NC - No Strontium Analysis Performed ND - Not Detected

APPENDIX E. (continued)

FIGURE AND NUMBER	LOCATION Azimuth and Distance	DATE MILKED	ISOTOPIC RESULTS (pCi/l) ^{131}I	^{133}I	^{137}Cs	^{89}Sr	^{90}Sr
4-30	Brown Ranch	1/28	ND	ND	ND	5	5
	Walti Hot Springs,	1/29	ND	ND	ND	ND	6
	Nevada	1/30	ND	ND	ND	NC	NC
	3°, 195 mi	1/31	ND	ND	ND	ND	7
		2/1	ND	ND	ND	NC	NC
		2/2	ND	ND	ND	NC	NC
31	J.D. Ranch	1/27	ND	110	ND	10	6
	Walti Hot Springs,	1/28	ND	ND	20	8	8
	Nevada	1/29	ND	ND	ND	7	8
	359°, 201 mi	1/30	ND	ND	ND	NC	NC
		1/31	ND	ND	ND	ND	9
		2/1	ND	ND	15	NC	NC
		2/2	ND	ND	ND	NC	NC
32	Darrell Weeks Ranch	1/29	20	55	ND	8	4
	Wells, Nevada	1/30	20	ND	20	6	2
	13°, 272 mi	1/31	ND	ND	ND	ND	5
		2/1	ND	ND	ND	NC	NC
		2/2	ND	ND	ND	NC	NC
		2/3	ND	ND	ND	NC	NC
		2/4	ND	ND	ND	NC	NC
33	Goble Ranch	1/29	ND	ND	ND	ND	4
	Wells, Nevada	1/30	ND	ND	ND	NC	NC
	12°, 280 mi	1/31	ND	ND	ND	NC	NC
34	Pohlsander Ranch	1/29	ND	ND	ND	12	7
	Wells, Nevada	1/30	40	ND	20	12	4
	13°, 284 mi	1/31	ND	ND	ND	8	7
		2/1	40	ND	20	11	6
		2/6	20	ND	ND	NC	NC
		2/8	25	ND	10	33	3
35	Willow Creek Ranch	1/28	70	220	60	14	6
	Wells, Nevada	1/29	50	110	15	22	2
	12°, 280 mi	1/30	ND	ND	ND	NC	NC
		1/31	25	ND	ND	18	4
		2/1	40	ND	ND	10	6
		2/2	ND	ND	ND	8	6
		2/4	ND	ND	ND	NC	NC
		2/5	ND	ND	ND	NC	NC
		2/6	ND	ND	ND	NC	NC

NC - No Strontium Analysis Performed ND - Not Detected

APPENDIX E. (continued)

FIGURE AND NUMBER	LOCATION Azimuth and Distance	DATE MILKED	ISOTOPIC RESULTS (pCi/l) ^{131}I	^{133}I	^{137}Cs	^{89}Sr	^{90}Sr
4-230	Cammack Dairy	1/30	ND	ND	ND	ND	7
	Blackfoot, Idaho	1/31	ND	ND	ND	NC	NC
	26°, 480 mi	2/1	ND	ND	ND	NC	NC
224	Idaho Creameries	1/27	ND	ND	ND	ND	6
	Boise, Idaho	1/30	ND	ND	ND	NC	NC
	2°, 470 mi	2/1	ND	ND	10	NC	NC
		2/2	ND	ND	ND	NC	NC
		2/3	ND	ND	ND	NC	NC
		2/4	ND	ND	ND	NC	NC
226	Smith's Dairy Produce	1/28	ND	ND	ND	ND	4
	Buhl, Idaho	1/29	ND	ND	ND	ND	6
	11°, 400 mi	1/30	ND	ND	ND	NC	NC
		1/31	ND	ND	ND	NC	NC
		2/1	ND	ND	ND	NC	NC
		2/3	ND	ND	ND	NC	NC
221	Couer D'Alene	1/28	ND	ND	13	NC	NC
	Creamery	1/29	ND	ND	ND	NC	NC
	Couer D'Alene, Idaho	2/1	ND	ND	ND	NC	NC
	359°, 755 mi	2/2	ND	ND	ND	NC	NC
		2/3	ND	ND	16	NC	NC
		2/5	ND	ND	10	NC	NC
		2/6	ND	ND	ND	NC	NC
223	Grangeville Creamery	1/27	ND	ND	ND	ND	7
	Grangeville, Idaho	1/28	ND	ND	35	ND	5
	1°, 625 mi	1/29	ND	ND	18	6	4
		1/30	ND	ND	15	NC	NC
		1/31	ND	ND	48	NC	NC
231	Wallace Dairy	1/28	ND	ND	ND	ND	9
	Idaho Falls, Idaho	1/30	ND	ND	ND	NC	NC
	2°, 745 mi	1/31	ND	ND	ND	NC	NC
		2/3	ND	ND	ND	NC	NC
		2/5	ND	ND	ND	NC	NC
227	Ida Gem Dairymen	1/27	ND	ND	ND	ND	6
	Jerome, Idaho	1/28	ND	ND	ND	ND	10
	14°, 410 mi	1/29	ND	ND	ND	ND	4
		1/30	ND	ND	ND	NC	NC
		1/31	ND	ND	ND	NC	NC
		2/1	ND	ND	ND	NC	NC
		2/2	ND	ND	ND	NC	NC

NC - No Strontium Analysis Performed ND - Not Detected

APPENDIX E. (continued)

FIGURE AND NUMBER	LOCATION Azimuth and Distance	DATE MILKED	ISOTOPIC RESULTS (pCi/l) ^{131}I	^{133}I	^{137}Cs	^{89}Sr	^{90}Sr
4-222	Golden Grain Dairy	1/29	ND	ND	ND	NC	NC
	Produce	1/30	ND	ND	ND	NC	NC
	Lewiston, Idaho	1/31	ND	ND	ND	NC	NC
	358°, 660 mi	2/1	ND	ND	12	NC	NC
229	Ward's Dairy	1/29	ND	ND	ND	ND	4
	Pocatello, Idaho	1/30	ND	ND	ND	NC	NC
	27°, 450 mi	1/31	ND	ND	15	NC	NC
		2/1	ND	ND	ND	NC	NC
		2/2	ND	ND	13	NC	NC
		2/3	ND	ND	ND	NC	NC
251	Beatrice Foods	1/29	ND	ND	ND	ND	6
	Billings, Montana	1/30	ND	ND	ND	6	3
	32°, 730 mi	1/31	ND	ND	ND	NC	NC
		2/1	ND	ND	ND	NC	NC
		2/4	ND	ND	ND	NC	NC
		2/5	ND	ND	ND	NC	NC
249	Darigold Farms	1/28	ND	ND	ND	ND	5
	Bozeman, Montana	1/30	ND	ND	ND	NC	NC
	24°, 670 mi	1/31	ND	ND	70	NC	NC
		2/2	ND	ND	ND	NC	NC
		2/5	ND	ND	ND	NC	NC
		2/6	ND	ND	ND	NC	NC
253	Gate City Dairy	1/28	ND	ND	ND	ND	6
	Glendive, Montana	1/30	ND	ND	ND	ND	6
	38°, 920 mi	1/31	ND	ND	ND	NC	NC
		2/1	ND	ND	ND	NC	NC
		2/2	ND	ND	13	NC	NC
		2/3	ND	ND	ND	NC	NC
245	Ayrshire Dairy	1/30	ND	ND	10	NC	NC
	Great Falls, Montana	1/31	ND	ND	ND	NC	NC
	19°, 775 mi	2/1	ND	ND	ND	ND	8
		2/2	ND	ND	ND	NC	NC
		2/3	ND	ND	ND	NC	NC
		2/4	ND	ND	ND	NC	NC
241	Equity Supply	1/30	ND	ND	ND	NC	NC
	Company	1/31	ND	ND	ND	NC	NC
	Kalispell, Montana	2/1	ND	ND	ND	NC	NC
	8°, 805 mi	2/2	ND	ND	16	NC	NC
		2/3	ND	ND	ND	NC	NC

NC - No Strontium Analysis Performed ND - Not Detected

APPENDIX E. (continued)

FIGURE AND NUMBER	LOCATION Azimuth and Distance	DATE MILKED	ISOTOPIC RESULTS (pCi/l) ^{131}I	^{133}I	^{137}Cs	^{89}Sr	^{90}Sr
4-252	Sanitary Dairy	1/29	ND	ND	ND	ND	9
	Miles City, Montana	1/30	ND	ND	ND	ND	8
	37°, 840 mi	1/31	ND	ND	ND	NC	NC
		2/1	ND	ND	ND	NC	NC
		2/2	ND	ND	ND	NC	NC
		2/3	ND	ND	ND	NC	NC
244	Community Creamery	1/27	ND	ND	ND	ND	7
	Missoula, Montana	1/28	ND	ND	ND	ND	9
	10°, 700 mi	1/29	ND	ND	ND	ND	6
		1/30	ND	ND	ND	ND	11
		1/31	ND	ND	ND	NC	NC
		1/31	ND	ND	20	NC	NC

NC - No Strontium Analysis Performed ND - Not Detected

APPENDIX F. Milk Cow Feed Sampling Results

FIGURE AND NUMBER	LOCATION Azimuth and Distance	TYPE OF FEED	DATE COLLECTED	EVENT RELATED ACTIVITY DETECTED
6-1	Murphy Ranch	Hay	1/29	No
	Arthur, Nevada	Hay	1/30	No
	12°, 256 mi	Hay	1/31	No
		Hay	2/1	No
2	Neff Ranch	Hay	1/30	No
	Arthur, Nevada	Hay	1/31	No
	11°, 250 mi			
3	Dry Creek Ranch	Hay	1/27	No
	Austin, Nevada	Hay	1/28	No
	350°, 164 mi	Hay	1/29	No
		Hay	1/30	No
		Hay	1/31	No
		Hay	2/1	No
4	Young's Ranch	Hay	1/27	No
	Austin, Nevada	Hay	1/29	No
	343°, 149 mi	Hay	1/30	No
		Hay	1/31	No
		Hay	2/1	No
5	Bill Lear Ranch	Hay	1/29	No
	Currie, Nevada	Hay	1/30	No
	20°, 230 mi			
6	Devil's Gate Ranch	Hay	1/28	No
	Deeth, Nevada			
	7°, 282 mi			
7	Lane Ranch	Hay	1/29	No
	Deeth, Nevada	Hay	1/30	No
	10°, 271 mi	Hay	1/31	No
		Hay	2/1	No
8	Lotspeich Ranch	Hay	1/28	Yes
	Deeth, Nevada	Hay	1/29	No
	10°, 274 mi	Hay	1/30	No
		Hay	1/31	No
		Hay	2/6	No
9	Mountain View Ranch	Hay	1/29	No
	Deeth, Nevada	Hay	1/31	No
	11°, 274 mi	Hay	2/1	No
		Hay	2/5	No
		Hay	2/6	Yes
		Hay	2/8	Yes
		Hay	2/14	No
		Hay	2/14	No
		Hay	2/14	No
		Hay	2/14	No

APPENDIX F. (continued)

FIGURE AND NUMBER	LOCATION Azimuth and Distance	TYPE OF FEED	DATE COLLECTED	EVENT RELATED ACTIVITY DETECTED
6-10	River Ranch	Hay	1/29	No
	Deeth, Nevada	Hay	1/30	No
	9°, 270 mi	Hay	1/31	No
		Hay	2/1	No
		Hay	/25	No
11	Winchell Ranch	Hay	1/29	No
	Deeth, Nevada	Hay	1/30	No
	11°, 275 mi	Hay	1/31	No
		Hay	2/1	No
12	Anchor S Ranch	Hay	1/28	No
	Elko, Nevada	Hay	1/30	No
	6°, 262 mi	Hay	1/31	No
13	LDS Welfare Farm	Hay	1/30	No
	Elko, Nevada	Hay	2/1	No
	6°, 239 mi			
14	Conaway Ranch	Grain	1/28	No
	Eureka, Nevada	Hay	1/28	No
	4°, 176 mi	Grain	1/29	No
		Hay	1/29	No
		Grain	1/30	No
		Hay	1/30	No
		Grain	1/31	No
		Hay	1/31	No
15	Labarry Ranch	Green Chop	1/28	No
	Eureka, Nevada	Hay	1/29	No
	6°, 181 mi	Hay	1/30	No
		Hay	1/31	No
		Hay	2/1	No
16	Liberty Livestock	Grain	1/28	No
	Ranch	Hay	1/28	No
	Eureka, Nevada	Grain	1/29	No
	4°, 174 mi	Hay	1/29	No
		Grain	1/30	No
		Hay	1/30	No
		Grain	1/31	No
		Hay	1/31	No
		Grain	2/1	No
		Hay	2/1	No
17	Palmore Ranch	Hay	1/28	No
	Eureka, Nevada	Hay	1/29	No
	5°, 181 mi	Hay	1/30	No
		Hay	1/31	No
		Hay	2/1	No
		Hay	2/5	No

APPENDIX F. (continued)

FIGURE AND NUMBER	LOCATION Azimuth and Distance	TYPE OF FEED	DATE COLLECTED	EVENT RELATED ACTIVITY DETECTED
6-18	Pollard Ranch	Hay	1/28	No
	Eureka, Nevada	Hay	1/29	No
	6°, 184 mi	Hay	1/29	No
		Hay	1/31	No
		Hay	2/1	No
		Hay	2/2	No
		Hay	2/5	No
19	Thompson Ranch	Pasture	1/28	No
	Eureka, Nevada	Hay	1/30	No
	5°, 190 mi	Hay	1/30	No
		Hay	1/31	No
		Hay	2/1	No
		Hay	2/2	No
20	Willow Ranch	Hay	1/27	Yes
	Eureka, Nevada			
	355°, 158 mi			
21	Barnes Ranch	Hay	1/30	No
	Jiggs, Nevada	Hay	1/31	No
	8°, 224 mi	Hay	2/1	No
22	Rose Ranch	Hay	1/30	No
	Jiggs, Nevada	Hay	1/31	No
	7°, 237 mi	Hay	2/1	No
23	Zunino Ranch	Hay	1/30	No
	Jiggs, Nevada	Hay	1/31	No
	7°, 229 mi	Hay	2/1	No
25	Circle Ranch	Hay	1/27	No
	Pancake Summit,	Hay	1/28	Yes
	Nevada	Hay	1/29	No
	8°, 169 mi	Hay	1/30	No
		Hay	1/31	No
		Hay	2/1	No
26	Cold Creek Ranch	Grain	1/27	No
	Pancake Summit,	Hay	1/27	No
	Nevada	Hay	1/28	No
	7°, 187 mi	Hay	1/29	No
		Hay	1/30	No
		Hay	1/31	No
		Hay	2/1	No
		Hay	2/2	No

APPENDIX F. (continued)

FIGURE AND NUMBER	LOCATION Azimuth and Distance	TYPE OF FEED	DATE COLLECTED	EVENT RELATED ACTIVITY DETECTED
6-27	Pinto Creek Ranch	Hay	1/28	No
	Pancake Summit,	Hay	1/29	No
	Nevada	Hay	1/30	No
	7°, 160 mi	Hay	1/31	No
		Hay	2/1	No
28	Martin Ranch	Hay	1/27	No
	Potts, Nevada	Hay	1/28	No
	356°, 136 mi	Hay	1/29	No
		Hay	1/30	No
		Hay	1/31	No
		Hay	2/1	No
		Hay	2/2	No
		Hay	2/5	No
29	Brown Ranch	Hay	1/28	No
	Walti Hot Springs,	Hay	1/29	No
	Nevada	Hay	1/30	No
	3°, 195 mi	Hay	1/31	No
		Hay	2/1	No
		Hay	2/2	No
30	J.D. Ranch	Hay	1/28	No
	Walti Hot Springs,	Hay	1/29	No
	Nevada	Hay	1/30	No
	359°, 201 mi	Hay	1/31	No
		Hay	2/1	No
		Hay	2/2	No
31	Darrell Weeks Ranch	Hay	1/29	No
	Wells, Nevada	Hay	1/30	Yes
	13°, 272 mi	Hay	1/31	Yes
		Hay	2/1	No
32	Goble Ranch	Hay	1/29	No
	Wells, Nevada	Hay	1/30	No
	12°, 280 mi	Hay	1/31	No
33	Pohlsander Ranch	Hay	1/29	No
	Wells, Nevada	Hay	1/30	Yes
	13°, 284 mi	Hay	1/31	Yes
		Hay	2/1	No
		Hay	2/6	No
		Hay	2/8	No
34	Willow Creek Ranch	Hay	1/28	Yes
	Wells, Nevada	Hay	1/29	No
	12°, 280 mi	Hay	1/30	Yes
		Hay	1/31	Yes
		Hay	2/1	No
		Hay	2/5	Yes
		Hay	2/6	Yes

APPENDIX G. Water Sampling Results

FIGURE AND NUMBER	LOCATION Azimuth and Distance	SAMPLE SOURCE	DATE COLLECTED	GROSS BETA (pCi/l)
7-1	Murphy Ranch Arthur, Nevada 12°, 25€ mi	Stream Stream	1/29 1/30	3 2
2	Neff Ranch Arthur, Nevada 11°, 250 mi	Stream	1/30	3
3	Dry Creek Ranch Austin, Nevada 350°, 164 mi	Spring Spring Spring Spring Spring	1/27 1/28 1/29 1/30 1/31 2/1	4 1 4 5 5 2
4	Young's Ranch Austin, Nevada 343°, 149 mi	Spring Spring Spring Spring Spring	1/27 1/29 1/30 1/31 2/1	2 2 2 <1 3
5	Pine Creek Ranch Belmont, Nevada 345°, 115 mi	Stock Tank	1/27	9
6	Rasmussen Texaco Carlin, Nevada 1°, 244 mi	Tap	2/1	10
7	Clark Station, Nevada 354°, 61 mi	Stock Tank	1/26 1/27	100 65
8	Currant Pond Currant, Nevada 21°, 112 mi	Pond	1/27	58
9	Bill Lear Ranch Currie, Nevada 20°, 230 mi	Spring Apring	1/29 1/30	13 14
10	Devil's Gate Ranch Deeth, Nevada 7°, 282 mi	Stock Tank	1/28	18
11	Lane Ranch Deeth, Nevada 10°, 271 mi	Stream Stream	1/29 1/30	16 19

APPENDIX G. (continued)

FIGURE AND NUMBER	LOCATION Azimuth and Distance	SAMPLE SOURCE	DATE COLLECTED	GROSS BETA (pCi/l)
7-12	Lotspeich Ranch Deeth, Nevada 10°, 274 mi	Stream	1/28	90
		Stream	1/29	44
		Stream	1/30	37
		Stream	2/6	24
13	Mountain View Ranch Deeth, Nevada 11°, 274 mi	Stream	1/29	12
		Stream	2/5	11
		Stream	2/6	5
		Stream	2/14	25
14	River Ranch Deeth, Nevada 9°, 270 mi	Stream	1/29	65
		Stream	1/30	88
		Stream	2/5	66
15	Winchell Ranch Deeth, Nevada 11°, 275 mi	Stock Tank	1/29	9
		Stock Tank	1/30	28
16	Duckwater Pond Duckwater, Nevada 15°, 123 mi	Pond	1/27	29
17	Anchor S Ranch Elko, Nevada 6°, 262 mi	Stock Tank	1/28	7
		Stock Tank	1/30	2
18	LDS Welfare Ranch Elko, Nevada 6°, 239 mi	Stream	1/30	<1
19	Conaway Ranch Eureka, Nevada 4°, 176 mi	Stock Tank	1/28	38
		Stock Tank	1/29	45
		Stock Tank	1/30	23
		Stock Tank	1/31	21
20	Labarry Ranch Eureka, Nevada 6°, 181 mi	Tap	1/28	18
		Tap	1/29	28
		Tap	1/30	14
		Tap	1/31	5
		Tap	2/1	16
21	Liberty Livestock Ranch Eureka, Nevada 4°, 174 mi	Stock Tank	1/28	27
		Stock Tank	1/29	15
		Stock Tank	1/30	30
		Stock Tank	1/31	22
		Stock Tank	2/1	32

APPENDIX G. (continued)

FIGURE AND NUMBER	LOCATION Azimuth and Distance	SAMPLE SOURCE	DATE COLLECTED	GROSS BETA (pCi/l)
7-22	Palmore Ranch	Tap	1/28	13
	Eureka, Nevada	Tap	1/29	20
	5°, 181 mi	Tap	1/30	14
		Tap	1/31	14
		Tap	2/1	23
		Tap	2/5	18
23	Pollard Ranch	Stock Tank	1/28	43
	Eureka, Nevada	Tap	1/29	8
	6°, 184 mi	Stock Tank	1/29	2
		Stock Tank	1/31	4
		Tap	2/1	5
		Tap	2/2	9
		Stock Tank	2/5	6
24	Thompson Ranch	Stock Tank	1/28	5
	Eureka, Nevada	Stock Tank	1/29	8
	5°, 190 mi	Stock Tank	1/30	<1
		Stock Tank	1/31	6
		Stock Tank	2/1	7
		Well	2/2	3
25	Willow Ranch	Well	1/27	<1
	Eureka, Nevada			
	355°, 158 mi			
26	Barnes Ranch	Stream	1/30	13
	Jiggs, Nevada			
	8°, 224 mi			
27	Rose Ranch	Stream	1/30	7
	Jiggs, Nevada			
	7°, 237 mi			
28	Zunino Ranch	Stream	1/30	2
	Jiggs, Nevada			
	7°, 229 mi			
30	Nyala, Nevada	Pond	1/27	141
	21°, 80 mi			
31	Circle Ranch	Pond	1/28	23
	Pancake Summit,	Pond	1/29	12
	Nevada	Pond	1/30	10
	8°, 169 mi	Pond	1/31	3
		Pond	2/1	<1
		Pond	2/2	2

APPENDIX G. (continued)

FIGURE AND NUMBER	LOCATION Azimuth and Distance	SAMPLE SOURCE	DATE COLLECTED	GROSS BETA (pCi/l)
7-32	Cold Creek Ranch	Stock Tank	1/27	10
	Pancake Summit,	Stock Tank	1/28	8
	Nevada	Stock Tank	1/29	2
	7°, 187 mi	Stock Tank	1/30	<1
		Stock Tank	1/31	<1
		Stock Tank	2/1	<1
		Stock Tank	2/2	<1
33	Pinto Creek Ranch	Stream	1/28	362
	Pancake Summit,	Stream	1/29	9
	Nevada	Stream	1/30	<1
	7°, 160 mi	Stream	1/31	23
		Stream	2/1	4
		Stream	2/2	14
34	Martin Ranch	Stock Tank	1/27	48
	Potts, Nevada	Spring	1/28	17
	356°, 136 mi	Spring	1/29	12
		Spring	1/30	7
		Spring	1/31	8
		Spring	2/1	8
		Stock Tank	2/2	7
		Spring	2/5	4
35	Brown Ranch	Spring	1/28	1
	Walti Hot Springs,	Spring	1/29	2
	Nevada	Spring	1/30	3
	3°, 195 mi	Spring	1/31	4
		Spring	2/1	3
		Spring	2/2	<1
36	J.D. Ranch	Stream	1/27	14
	Walti Hot Springs,	Pond	1/28	29
	Nevada	Pond	1/29	17
	359°, 201 mi	Pond	1/30	10
		Pond	1/31	6
		Pond	2/1	9
		Pond	2/2	3
37	10 mi NE of Warm Springs on Highway 6, Warm Springs, Nevada 0°, 80 mi	Pond	1/27	366
38	Fallini's Pond Warm Springs, Nevada 5°, 72 mi	Pond	1/27	516

APPENDIX G. (continued)

FIGURE AND NUMBER	LOCATION Azimuth and Distance	SAMPLE SOURCE	DATE COLLECTED	GROSS BETA (pCi/l)
7-39	Darrell Weeks Ranch	Stock Tank	1/29	7
	Wells, Nevada	Stream	1/30	<1
	13°, 272 mi			
40	Goble Ranch	Well	1/29	9
	Wells, Nevada	Tap	1/30	23
	12°, 280 mi			
41	Pohlsander Ranch	Pond	1/29	50
	Wells, Nevada	Pond	1/30	14
	13°, 284 mi	Pond	2/6	27
42	Willow Creek Ranch	Stock Tank	1/28	13
	Wells, Nevada	Stock Tank	1/29	1
	12°, 280 mi	Stock Tank	1/30	6
		Stock Tank	2/5	5
		Stock Tank	2/6	2

PROJECT CABRIOLET REPORTS

Report	Agency	Author	Title
PNE-950	LRL		Cabriolet Summary
PNE-951	Sandia	L. Vortman	Close-In Air Blast
PNE-952	Sandia	J. Reed	Long-Range Air Blast
PNE953	LRL	L. D. Ramspott R. T. Stearns G. L. Meyer	Preshot Geophysical Studies of Cabriolet Nuclear Crate Site
PNE-954	EG&G	R. L. Lynn D. G. Crandall	Spectroradiometric Detection of Effluents
PNE-955	LRL	J. J. Cohen	Special Cloud Content Studies
PNE-956	EG&G	W. A. Rhoads R. B. Platt R. A. Harvey E. M. Romney	Ecological and Environmental Effects from Local Fallout from Cabriolet
PNE-958	ERG	R. W. Klepinger R. A. Mueller	Analysis of Ground Motion
PNE-959	EPA		Report of Off-Site Surveillance for Project Cabriolet
PNE-963	LRL	R. F. Rohrer	Cabriolet Surface - Motion and Vented - Gas Temperature Measurements
PNE-964	LRL	R. E. Marks	Measurements of Subsurface and Close-In Surface Dynamic Effects
PNE-966	WES	R. W. Hunt D. M. Bailey L. D. Carter	Preshot Geological Engineering Investigation for Project Cabriolet, Pahute Mesa, NTS

TENTATIVE REPORTS

	LRL	T. Gibson	Ground Radiation Survey
	LRL	R. Rohrer	Cloud and Surface Measurements
	NCG		Crater Topography